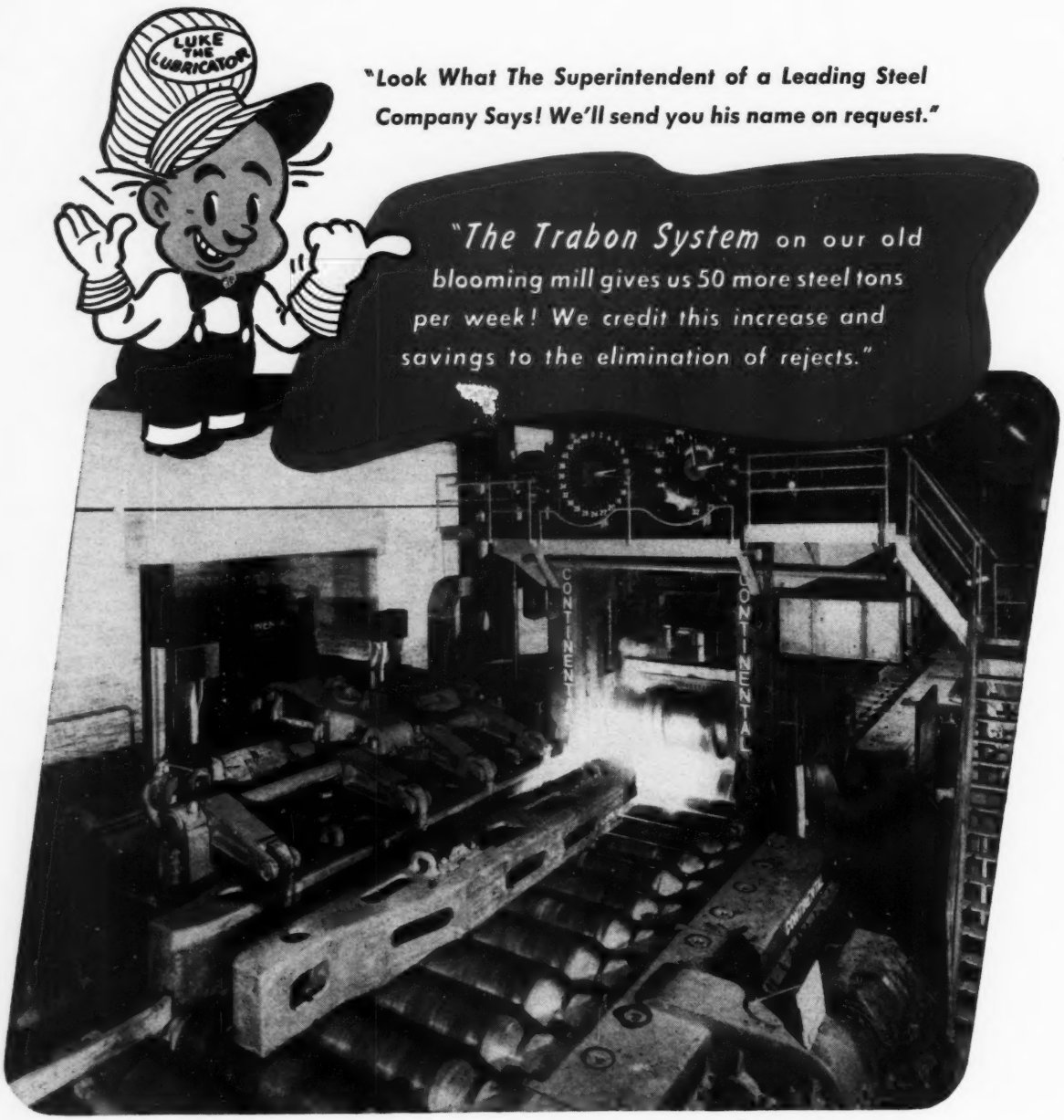
Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS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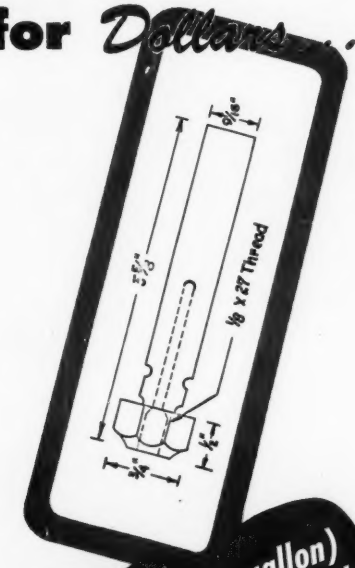

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Lubrication ENGINEERING

VOL. 7 JUNE, 1951 No. 3

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LUBRICATION ENGINEERING
Official Publication of the American Society of Lubrication Engineers
343 S. Dearborn Street, Chicago 4, Ill.

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Northwestern Technological Institute
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Subscription — $4.00 annually. Single copies — $.75. Published bi-monthly.

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Printed in Cincinnati, Ohio, by S. Rosenthal & Co., Inc.

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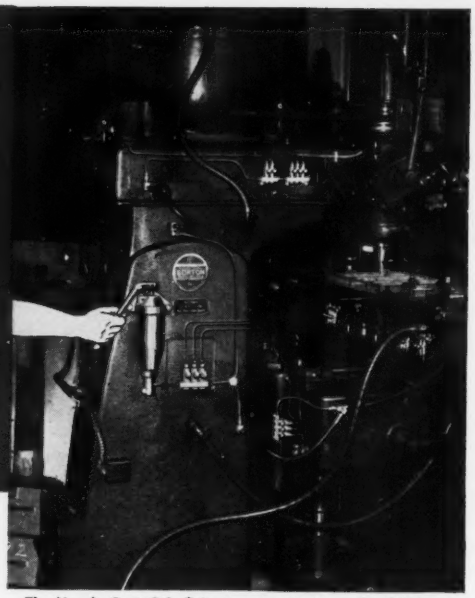

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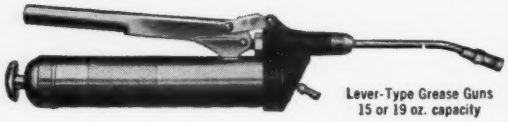

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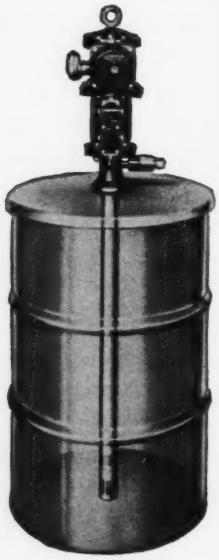

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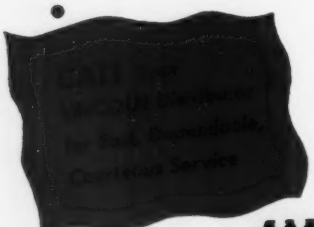

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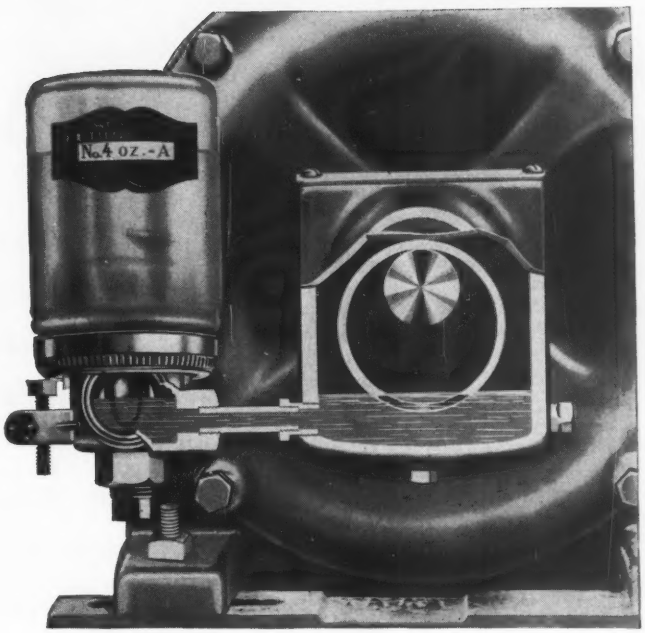

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8-23-49	170-4 oz. "
9-26-49	174-4 oz. "
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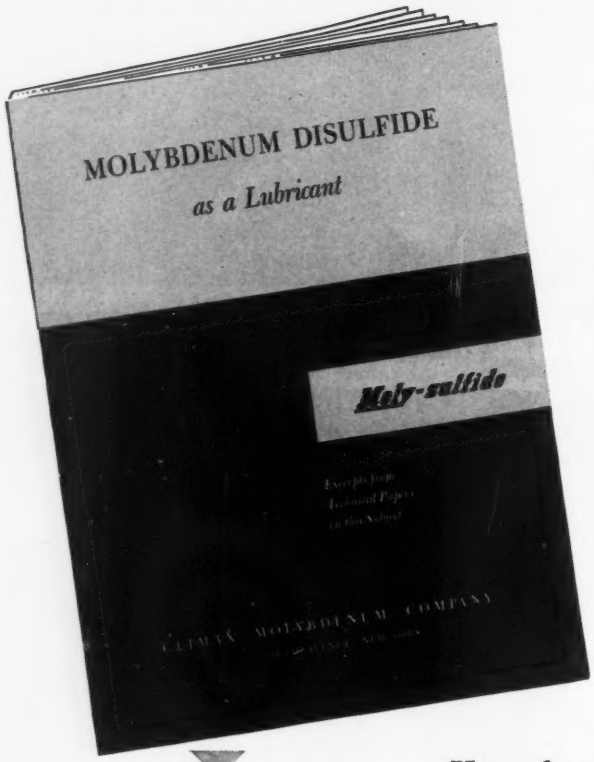

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PRESIDENT'S MESSAGE

The American Society of Lubrication Engineers enters its seventh year, a vigorous, energetic, scientific Society filling a long-felt need in industry.

To develop the scientific aspects of lubrication with its diversity of problems a General Technical Committee was established in 1950. The General Technical Committee work is augmented by sub-committees under the leadership of outstanding men in science and industry who have been selected on the basis of their knowledge and experience to handle the many phases of lubrication as it applies to industrial America. The chairmen of these sub-committees have surrounded themselves with personnel well qualified to give technical and practical information to industry concerning the varied aspects of lubrication.

The Society is sponsoring a summer educational course at the Massachusetts Institute of Technology. These sessions will deal with lubrication engineering in its several phases. The success of this undertaking will lead to the establishment of similar courses in other of the country's prominent educational institutions.

The twenty-four Sections of our Society reaching from coast to coast hold monthly meetings where papers of interest on lubrication and related subjects are presented by outstanding men who are in a position to know the needs of industry in the sectional area involved.

The functioning of the local Sections has recently been strengthened by Sectional sustaining memberships, thus enabling the local groups to broaden the scope of their activities.

The Journal of the Society, LUBRICATION ENGINEERING, published bi-monthly, carries information of interest to those engaged in the solution of lubrication problems throughout the world. Papers and experience data at practical and technical levels are gathered from world-wide sources, thus accumulating ideas and experiences for the benefit of everyone in the field.

The Society has members in twenty-four foreign countries, which indicates the international interest in the aims and purposes for which this Society was established.

At our Annual Meetings noted authorities offer prepared papers and conduct informal discussions on topics which are of concern to our members and guests. Each year our growing convention registration is drawn not only from every state in the Union but many foreign countries as well.

Our Lubrication Exhibit held in conjunction with the meeting is ever broadening in scope and provides an opportunity to view the newest developments, principles and applications of the leading manufacturers of lubricants and lubrication devices.

Never before in the history of the nation has the importance of lubrication been so vital a factor in the national economy as under the conditions which exist at the present time. Our Society with its background of technical and practical information can and will be ready to meet the problems confronting industry in the national emergency which we now face. The American Society of Lubrication Engineers, its Officers, Directors and entire membership dedicates itself to serve industrial America and the Armed Forces faithfully and energetically.

CARL E. SCHMITZ

Carl E. Schmitz, Vice President, Director of Engineering, Crane Packing Company, has been engaged in engineering work since 1921.

Born August 21, 1897, at Cedar Lake, Indiana, he attended Joseph G. Branch School of Engineering and later did special work at University of Illinois.

Mr. Schmitz has been engaged in supervisory engineering positions with such organizations as Locomotive Crane Company of America, Barber Asphalt Company, Owner of Peerless Equipment Division of Emerson-Scheuring Tank Co., General Manager Viking Pump Company of Canada, Ltd., and Technician Atlas Engineering and Machine Company, Ltd.

He joined Crane Packing Company as Technician in 1942, advancing to position of Vice President, Director of Engineering on January 1, 1947.

Mr. Schmitz is actively associated with many technical societies; he is a member of AAAS, ASRE, ASME, ASLE, Engine Committee of SAE, Chairman of Sub-Committee Water Pump Seals, and has for two years been a member of the National Conference on Industrial Hydraulics.

He is affiliated with the Chicago Engineers' Club and the Chicago Rotary Club. He is a Past Chairman of the Chicago Section of our Society and was elected President of the American Society of Lubrication Engineers in 1951.

Mr. Schmitz married the former Madeline E. Vergen of Champaign, Illinois, on June 14, 1928. They have one son and one daughter and live in Park Ridge, Illinois.

NUMBER 4

TEXTILE SPINDLES AND THEIR LUBRICATION

*by F. S. Jones**

Lubricating Department
Socony-Vacuum Oil Company, Inc.
26 Broadway, New York 4, N. Y.

* We regret to announce the sudden and unexpected death of Mr. Fredrick S. Jones in March of this year.
We feel that our readers will be interested in the biographical background of Mr. Jones. Past experience ably qualified him to write the Practical Paper on Textile Spindle Lubrication for our Educational Series.
Mr. Jones received his B.S. degree in Electrical Engineering in 1914 at the University of Maine. His early background was with the General Electric Co. where he had considerable experience as Turbine Specialist.
His initial association with the Socony-Vacuum Oil Co. was in the capacity of Chief Engineer. In 1942 he transferred to the Executive Offices of Socony-Vacuum and there served, until his death, as Staff Engineer in the Industrial Division of the Lubricating Oil Department.
In 1950 he received the professional degree of Mechanical Engineer, also from the University of Maine. He was registered as a Professional Engineer in three states: Maine, Massachusetts and New York. Mr. Jones was very active in numerous Engineering Societies and their committee work.

Spinning Spindles

The ring-spinning frames, which are predominant in the cotton-textile industry, give the previously processed rovings their final draw and twist. Here a definite size and strength are imparted to the finished yarn.

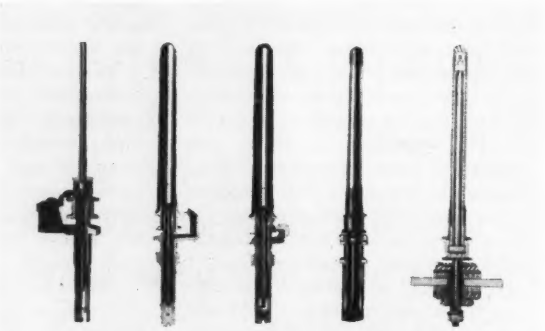
These machines consume approximately 50 per cent of the power required by the entire mill. And approximately half the power used by the frames is consumed by the spindles. From the standpoint of lubrication, therefore, these spindles constitute the most important assembly on a ring-spinning frame. The following benefits can be expected from good lubrication:

a) Low power consumption;
b) Reduced bolster wear and less maintenance;
c) Less spindle wobble and fewer "ends down";
d) Greater production of more uniform yarn.

Types of Spinning Spindles

A number of designs of ring spindles are encountered in modern cotton mills. These include—

a) Spindles with plain cast-iron bolsters, and cast-iron steps and guides (Fig. 1a);
b) Spindles with plain bolsters of steel tubing, and with porous-metal inserts for steps and guides (Fig. 1b);
c) Spindles with plain steps and ball- or roller-bearing guides (Fig. 1c);
d) Spindles equipped entirely with ball bearings (Figs. 1d and 1e).



1a 1b 1c 1d 1e

Inspection and Maintenance

Oil Level

If a constant level of oil could be maintained in ring-spinning spindles, bolster life could be greatly improved, and greater uniformity in production could be constantly maintained. Actually, this is next to impossible, but an approach to this ideal condition can be made by—

a) Oiling at frequent intervals. Once or twice a week should help in keeping a suitable level;
b) Oiling when the frames are shut down. This reduces the likelihood of over-oiling and excessive oil throw.

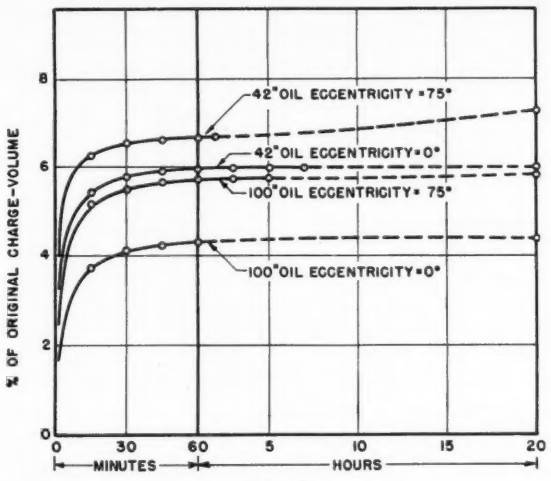


Fig. 2
Textile Spindle Oil Throw Curves

Oil Throw

When a spinning frame is first started, ring spindles may throw oil, as shown in Fig. 2. When this happens, most of the throw will take place during the first half-hour. If there is no spindle wobble, this throw will usually stop within an hour. Light spindle oil will throw more, and will suffer a greater continuing loss with spindle wobble, than a heavier oil.

Cleaning and Replacements

In order to remove contamination, spindle oil should be drained at least once a year. The spindles should then be flushed and filled with new oil. If disassembled for cleaning and inspection, the complete assembly should be kept together when reassembled.

At cleaning time, bolsters should be gaged for size. If the bolster has worn so that the clearance is more than .006 in. on the diameter the bolster should be replaced. The bolsters of wobbling spindles should be gaged at any time they are observed to be out of balance, and replaced if necessary.

Power Consumption

Plain bolsters are predominant in the cotton-textile industry. Carefully controlled laboratory tests have been conducted under exacting conditions to determine their operating characteristics, and the effect of those characteristics on power consumption.

Relation of Spindle Speed to Power

An increase or decrease of 1.2 watts per spindle has been noted for an increase or decrease of 1000 rpm of the spindle (Fig. 3). This holds true within the normal range of spindle speeds—namely, between 7000 and 11,000 rpm.

Relation of Oil Viscosity to Power

For increase or decrease of 20 S.S.U. in viscosity, an increase or decrease of 1.2 watts per spindle has been observed (Fig. 3). There is a limit, however, to the speed and weight of package at which an oil of given viscosity will perform satisfactorily. When the spindle that was used in this test operated at 10,670 rpm, it failed with a 60 S.S.U. spindle oil, but operated satisfactorily with an 80 S.S.U. oil.

The lightest spindle oil that provides satisfactory bolster maintenance gives the greatest saving in power.

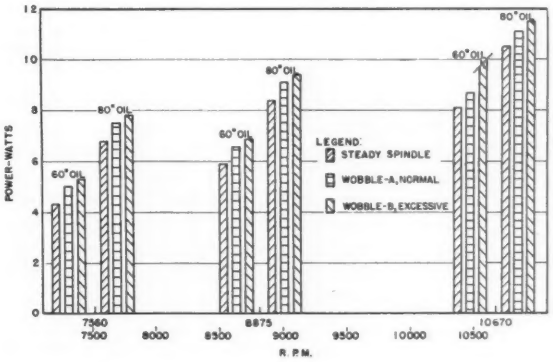


Fig. 3
Textile Spindles-Power vs Wobble Chart

Relation of Spindle Wobble to Power

Excessive spindle wobble is one of the greatest influences on power consumption. Moreover, it has no small influence on "ends down" and quality of yarn. The curves in Fig. 3 show that moderate wobble has the effect of increasing the power consumed by a single spindle by .8 watt, and by as much as 1.0 watt if the wobble is excessive.

Relation of Package Weight to Power

As a package builds up on a bobbin, the power consumed by the spindle increases during the period between doffs. Curves showing the relation between weight of package and power consumed indicate an increase or decrease of .25 watts per spindle for an increase or decrease of 5 oz. in the weight of the package (Fig. 4).

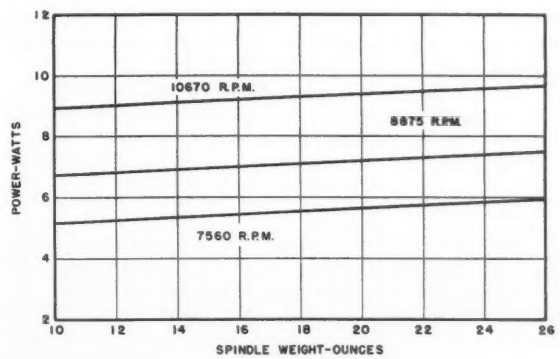


Fig. 4
Textile Spindles-Steady Spindle 80" Oil Power-Weight Curves

Selection of Most Suitable Spindle Oil

The many studies and tests of the performance of spindle oils show the need for a careful study of the operations of a mill, in order to—

a) Choose an oil of the best quality for long-time service;
b) Choose an oil best suited in viscosity for low power consumption, minimum vibration and low bolster maintenance;
c) Schedule best timing of re-fill periods to assure maintenance of constant oil level;
d) Avoid bolster wear that results in a clearance of more than .006 in. on the diameter;
e) Avoid spindle wobble, whether caused by too light an oil, worn bolsters or unbalanced bobbins;
f) Arrive at lowest power cost for maximum-demand charge and kw.-hr. consumption, and still have good-running spindles.

The oil in an oil-lubricated spindle behaves like a miniature circulation system. The centrifugal action of the tapering spindle forces the oil outward and upward, from where it drains back to the spindle base. Only a high-quality oil, capable of resisting oxidation and thickening in long-time service, should be used. The best viscosity will depend on such factors as spindle speed and weight of package, and their effect on power consumption and bolster wear.

The more recent designs that use anti-friction bearings have shown appreciable savings in power, as compared with the older spindles, using plain bolsters and guides. Some of these more recent designs are lubricated with oil, while others are lubricated with grease.

Spindles with Anti-Friction-Bearing Guides

Ring spindles, having plain bolsters and steps, and ball- or roller-bearing guides, are lubricated with oil. The steps are submerged in oil, but the anti-friction bearings receive their lubrication either by splash, or by means of capillary wicks. Usually, a 60 S.S.U. high-quality spindle oil is entirely satisfactory. The level of oil should be maintained with the same care that is exercised in the case of other oil-lubricated spindles. These spindles usually consume as much as 15 per cent less power than spindles with plain bolsters, steps and guides.

In some cases, when the humidity of the surrounding atmosphere is high, rusting has been encountered. Under such conditions, the use of a spindle oil with rust-inhibiting characteristics has been found beneficial.

All-Ball-Bearing Spindles

Spindles that are equipped entirely with ball bearings are lubricated at the point of manufacture with a high-quality anti-friction-bearing grease. They require re-lubrication approximately every 3 years. This can be done at the mill if the special equipment that is required is available. Otherwise, they can be sent to the manufacturer for servicing.

These spindles usually consume as much as 50 per cent less power than older spindles with plain bolsters, steps and guides.

Twister Spindles

Twisters take spun yarns, and twist two or more strands spirally around each other to make ply yarns of greater strength. Twister spindles carry larger packages than spinning spindles, and are more heavily loaded. The possibilities for saving power by good lubrication, therefore, are even greater than in spinning.

Lubrication

The same care and attention are required in the lubrication, inspection and maintenance of twister spindles as in the case of spinning spindles.

The best oil for twister spindles is a high-quality oil that will resist oxidation and thickening in a long-time service. It should be heavy enough to protect against bolster wear, and light enough to give low power consumption. Its viscosity, therefore, will depend to a large extent on spindle speed and weight of package.

Twister spindles with plain bolsters need a heavier-bodied oil than spinning spindles, in order to compensate for the heavier twist on packages that are carried.

Roller-bearing twister spindles, with oil bolsters, operate satisfactorily with an oil lighter in body, but still heavy enough to cushion vibration.

Conclusion

When careful attention is given to the proper operation of spinning and twister spindles, and when a suitable lubrication practice is adopted and regularly followed, the best results are obtained. The following suggestions are offered:

1. Choose a high-quality spindle oil of the proper viscosity for a given spindle speed and weight of package.
2. Carefully maintain proper oil levels, insofar as it is practical to do so.
3. Establish draining, cleaning and re-filling schedules to keep spindle oils free from contamination, and to protect bolsters against excessive wear. When disassembled for cleaning and inspection, keep complete assembly together when reassembling.

The adoption of a well considered lubrication practice will result in—

a) Power savings;
b) Improved production;
c) Low maintenance;
d) Economical lubrication.

LIQUID AND VAPOR CORROSION INHIBITORS* †

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ABSTRACT

Progress of post-war research is reported on polar-type rust inhibitors. New material is presented on: the structure of soaps and of amine-acid complexes, the colloid state of polar compounds in non-aqueous systems, adsorption on metals, and the mechanism of corrosion inhibition. Advances in rust inhibition test methods are reviewed including recent work on vapor-type inhibitors.

I. Introduction

The results of our work during World War II on the theory and properties of rust inhibitors in oils were summarized by us three years ago ([1, 2]). The intimate relation between the rust inhibiting and wear preventive properties of polar-type compounds dissolved in oils have been discussed by Brophy and Zisman more recently ([3]). Postwar research at NRL on corrosion inhibitors for nonaqueous systems has been concerned with the nature of soaps and of the ammonium salts of high molecular weight acids, the existence and structure of micelles in oils, the structure of inhibiting films, and the properties of vapor-type rust inhibitors. It is the purpose of this paper to review this new material.

II. Colloidal Condition of Rust Inhibitors

We have shown ([1, 2]) that the compounds most suitable for polar-type rust inhibitors should be as high in molecular weight as possible. But increasing the molecular weight in any homologous series of organic compounds eventually decreases the solubility in oil. Hence, the best rust inhibitors rarely are sufficiently soluble in oils at ordinary or low temperatures. Therefore, the development of a rust inhibited oil involves a compromise between the conflicting requirements of avoiding precipitates during storage and obtaining maximum rust inhibition. These troubles are generally encountered when the inhibitor concentration is over 0.5 to 1.0%. Few lubricants and rust preventive fluids are free from significant losses in rust inhibition after storage at ambient temperatures for six months. Even when such oils at first evidence no more Tyndall effect in white light than the non-additive oils, pronounced effects usually develop in a year. Frequently a faint haze develops in the oil which is most pronounced at the bottom of the storage tank.

Experimentation on the colloidal condition of oils is often difficult because of the metastability of the solutions formed. As the additive and the oil generally have nearly equal refractive indices, ordinary optical methods of observing colloids are not suitable. We have frequently found it useful to observe qualitatively the presence of polar additives as fine precipitates or colloids by observing the spreading behavior of a drop of oil on the grease-free surface of water in a "hydrophil" tray ([3]). When the polar additive is in solution, uniform spreading of the oil drop results. But, whenever numerous rapidly growing holes or small colored spots have appeared at the oil-water interface of the spreading drop, we have always found later that the additive was not all in solution in the oil.

Salts of the high molecular weight carboxylic acids (such as the naphthenates) and the sulfonic acids are the most useful, cheap rust inhibitors. It is now recognized that such "soaps" when dispersed in nonpolar solvents form colloidal systems. Many years ago Soyenkoff ([4]) reported evidence that nickel stearate and ferric

* The opinions or assertions contained in this paper are the authors' and are not to be construed as official or reflecting the views of the Navy Department.

† Paper presented at 6th Annual Meeting, ASLE, Philadelphia, April 18, 1951.

stearate in benzene solution were associated, and more recently Gonick [5] and McBain and Working [6] showed through cryoscopic and osmotic studies that various soaps and other amphipathic compounds were associated in benzene or cyclohexane solutions.

Singleterry and Arkin of our Laboratory discovered several years ago that certain fluorescent dye indicators, (especially Rhodamine B) can be used in nonaqueous systems to demonstrate the existence of micelles (see Fig. 1 and Fig. 2) and to measure the critical micelle concentration of such amphipathic compounds as various calcium, sodium and lithium soaps of carboxylic acids and various alkyl sulphonates and petroleum sulphonates in benzene, cyclohexane, diesters and higher boiling aliphatic hydrocarbons [7, 8]. They found that micelles persisted to much lower concentrations in these organic solvents than in water. For example, the minimum concentration for micelle formation of several different calcium arylstearates in benzene was between 10^{-5} and 10^{-6} moles/liter. Also they were able to employ measurements of the polarization of the fluorescent light emitted by such oil systems to calculate the average volume of micelles [8]. Evidently, valuable tools are now available for research on the existence and size of micelles in lubricants, fuels and other nonaqueous systems.

III. Properties of Soaps in Nonpolar Liquids

It has become evident in the past seven years that many types of soaps are polymers when anhydrous. McBain and Working [6] and later Gray and Alexander [9] and Sheffer [10] showed that pure anhydrous aluminum laurates were polymers. Gray and Alexander [9] proposed a structural arrangement (see Fig. 3) in which the polymer was held together through coordination between the aluminum atoms and the hydroxyl groups. Arkin and Singleterry [11] soon after demonstrated that the anhydrous calcium, sodium and lithium soaps of arylstearic acids also were polymers (see Fig. 4), and the addition of one mole of water per mole of disubstituted soap caused complete dissociation of the polymer. The mode of combination of the divalent and univalent soap polymers is not precisely known, but some form of coordination between the metal atoms is believed to exist. These studies open a wide area for research on the soaps and their applications.

Although McBain and coworkers have shown that aluminum "trilaurate" is a mixture of aluminum dilaurate and associated free acid, it is still not widely recognized that other soaps are variable chemical compositions. As examples, many of the aryl stearates of Be, Mg, Ca, Sr, Ba, Zn, or Al have been prepared at our Laboratory either in the liquid state in a wide range of viscosities or as dry, non-crystalline solids [12]. Liquid products result when more than two moles of acid combine with a gram atomic weight of a divalent metal. The solid product is obtained when the less firmly associated acid has been removed by a long refluxing with hot acetone in a Soxhlet extractor. Beyond a doubt, the soaps of carboxylic acids have the ability to associate to a continuously variable extent with acid. The mechanism of acid uptake by the soaps is not clear yet. It may be either through cooperative micelle formation or hydrogen bonding or a combination of the two mechanisms.

A soap serves as a "source" of carboxylic acid which is released by thermal treatment or hydrolysis, or it can serve as a "sink" or "getter" of excess carboxylic acid in the system if the soap is not initially saturated to its full capacity. Further research is evidently needed on the structures and equilibria involved. If it is desired

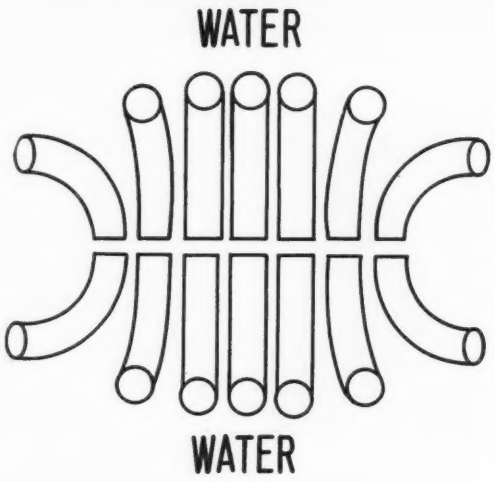


Fig. 1
Typical Aqueous Micelle Size, 40-50 Acid Residues

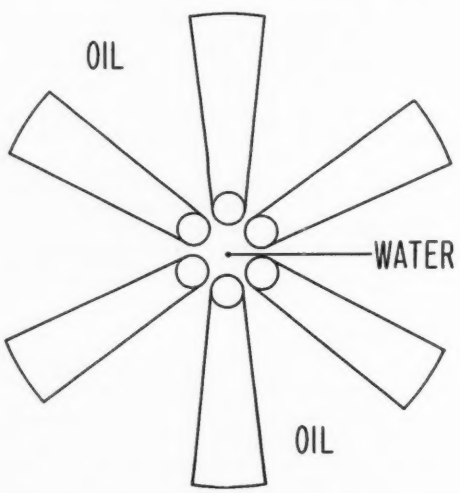
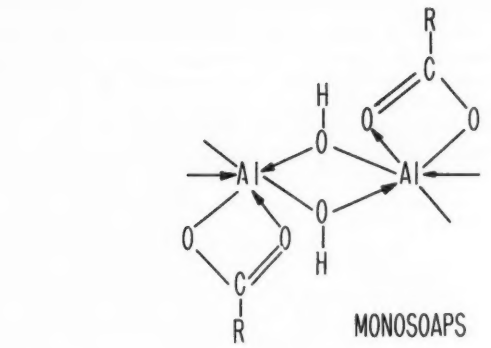


Fig. 2
Association of Arylstearate Soaps In Hydrous Non-Polar Liquid Size, 40-50 Acid Residues

to disperse the soap in an oil, one might call the excess acid usually needed the peptizer or the "coupling agent" of the soap. A soap not saturated with acid can be used as an acid "getter" or "neutralizer." Among the oxidation products of oils are insoluble, weak acids. It is probable that the association of such acids with a soap dispersed in the oil is one of the mechanisms by which oils can be made detergent.

IV. The Amine "Soaps" and Mode of Combination

When amines are reacted with the carboxylic acids of high molecular weight, the resulting products often called amine "soaps" or "ammonium soaps" are frequently used as rust inhibitors in oils and hydrocarbon solvents. The most basic amines are commonly used to neutralize acids in nonaqueous systems [1, 2]. Ammonium compounds are formed in the reaction with strong acids, but there has been much evidence for believing that the reaction with weak acids such as the fatty acids is through hydrogen bonding to the amine nitrogen atom. Until recently we believed that these "com-



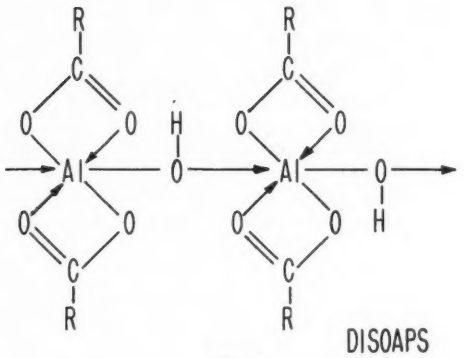


Fig. 3
Structure of Aluminum Soaps Suggested by Gray & Alexander

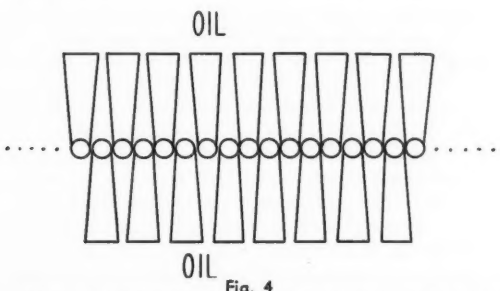


Fig. 4
Association of Arylstearate Soaps In Anhydrous Non-Polar Liquid Size, Hundreds of Acid Residues

pounds" also were associated as micelles. But Kaufman and Singleterry [13] of our Laboratory have succeeded in demonstrating from cryoscopic measurements and theoretical calculations that the most basic tertiary amines react with such carboxylic acids to form hydrogen bonded association complexes which may include from a minimum of two to a maximum of four moles of acid per mole of amine. Also no micellar structures were formed.

It is well known that the basic amines effectively combine with and neutralize *strong* acids like HCl or HBr; but we can now state that they can only associate with a *weak* acid and reduce its concentration to a low level which depends upon the relative molal proportions of the acid and amine (see Fig. 5). As the hydrogen bond has an energy of less than 6 kilocal./mole, one can predict decreased association tendencies of weak acids with amines at high temperatures. Therefore, the effectiveness of the amines in neutralizing weak acids will decrease as the temperature rises. The precise mode of combination of either primary or secondary amines with weak acids has not been established yet, but unquestionably hydrogen bonding to form complexes takes place. It is concluded that the products of the reaction of amines and weak acids should be called amine-acid complexes and not "amine salts" or "ammonium soaps."

V. The Adsorption of Polar Molecules

Recently, Greenhill [14] reported obtaining isotherms of stearic acid, octadecyl alcohol and ethyl stearate adsorbed from benzene solution upon clean powders of copper, nickel, silver, iron and platinum. Comparison of the adsorption isotherms for the different solutes shows the large differences in the rates of adsorption on a given metal of the acid, alcohol and ester previously revealed in our work [1, 18]. Since the iron powder particles used by Greenhill were spherical, the area could be computed approximately thus permitting him to show that the adsorbed film at surface saturation was very nearly a close-packed monolayer. From subsequent experiments with radioactive metal foils and from related electron diffraction measurements, Bowden and Moore [15] and Sanders [16] concluded that Frewing and others who reported the strong adsorption of monoesters on metals were mislead by the effects of traces of acid impurities. This confirms our earlier conclusions from studies of adsorption [17] and rust inhibition [1, 2, 3].

Barnum, Larsen and Wachter [18] have reported briefly on their experiments on the adsorption of polar rust inhibitors on iron powder in a refined mineral oil at 30°C. The surface area of the powder was measured by the BET method using the adsorption of nitrogen. Changes in concentration due to adsorption were obtained from measurements of the interfacial tension at an oil-water interface. They concluded that adsorbed films of various classes of polar-type rust inhibitors were always thicker than one or two molecular layers. But from the concentrations used by them (0.1% to 1.0%) and from our previous discussion, we can conclude that

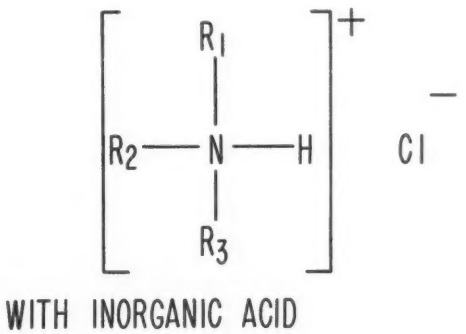


Fig. 5
Tertiary Amine-Acid Combination

in the oil systems studied some of the rust inhibitor was in colloidal condition. It is highly probable that such colloidally dispersed material deposited on the metal powder along with the adsorbed monolayer and hence the calculated amount adsorbed per unit area was too high. When the inhibitor is a colloid, we believe that steel surfaces immersed in the oil will in time become coated with an adsorbed monolayer on top of which is a discontinuous deposit of precipitates or aggregates of the inhibiting compound.

The same workers also have discussed their experiments on the rust preventive properties of Langmuir-Blodgett multilayers deposited on steel by transfer from water [18]. Such observations do not relate to the rust preventive properties of the films on iron in adsorption equilibrium with the polar solute in oil. The improved rust inhibition of these multilayers obtained after they were soaked with the mineral oil can be accounted for by the ability of molecules of the oil to seal the cracks and pores which are well known to exist in such multilayers.

Adsorption of some aliphatic acids, amines, alcohols and esters from benzene solution on steel powder has been reported recently by Hackerman and Cook [19]. Concentrations of from 0.01% to 0.5% by weight were used. No limiting values were obtained in the adsorption curves. A considerable proportion of the material initially adsorbed could be desorbed by repeatedly contacting the film-coated steel surface with pure benzene until desorption ceased. Interpretation of their data is difficult because of two experimental complications: first, at the upper concentration range used, the possibility of the presence of colloids and colloidal deposits was ignored; and second, the desorption observed at all concentrations may have been due to the removal of the film deposited on the less adsorptive areas of the steel powder whose surface homogeneity is questionable. Hence, their conclusion that the adsorbed films were thicker than a monolayer was not established.

It can be concluded that no acceptable data have been published yet to demonstrate the adsorption of polymolecular films of the types of polar molecules of interest in rust inhibition.

VI. The Mechanism of Rust Inhibition

As the van der Waals forces between adsorbed molecules contribute significantly to the energy of adsorption of a monolayer of long-chain polar molecules [20], the adsorption of the amine-acid complex is much less probable than that of the acid released by it. The greater effectiveness of the amine-acid complex as an inhibitor than the amine alone especially at temperatures of 140 F. or more [1] makes it unlikely that adsorption of acid and amine as a mixed film is responsible. It is, therefore, concluded that the rust inhibiting property of amine-carboxylic acid complexes is due to their ability to supply the carboxylic acid needed to coat the ferrous surfaces with adsorbed hydrophobic films. The rust inhibition observed need not be identical with that obtained from the addition of the same amount of acid to the oil. This is because of the great influence of the solubility on the dynamic equilibrium between the acid molecules in the adsorbed film with those dissolved in the oil. Therefore, the acid donating additive must either be dissolved or finely dispersed to saturate the oil with acid. Obviously the dispersed acid would be more likely to precipitate or aggregate than the amine-acid complex. Finally, as much as possible of the acid which is not adsorbed must be neutralized so as to decrease the probability of acid corrosion of bearings or other nonferrous metals.

The use of amine-acid complexes will furnish a more useful way to disperse acid inhibitors and to get a high degree of rust inhibition than through the use of the dimerizing (or hydrogen bonding) tendency of acids (as through the use of mixed acids) because:

(a) One mole of the amine associates with two to four moles of acid, while one mole of an acid associates with only one mole of acid.

(b) If the amines are so selected as to help peptize or disperse the rust inhibiting acid, it becomes practicable to use an organic acid having the surface chemical structure most suitable for obtaining optimum rust prevention and the inevitably lower solubility in oils.

However, the amine-acid complexes have the limitation that the unassociated amine always present may react with copper, silver, and other bearing metals to cause corrosion. Their use may be impractical at elevated temperatures without a metal deactivator.

In considering the mechanism of rust inhibition by soaps, it is essential to distinguish between the inhibiting action of soaps formed "in situ" (by the reaction of the acid with the ferrous metal surface to form the soap) and that of soaps adsorbed as such on the surface of the steel. Dubrisay [21] and Prutton [22] have shown that such soaps form only after the formation of the metal oxide. Tingle [23] recently demonstrated that the reaction of iron with a dilute fatty acid solution in oil is greatly accelerated by the presence of water.

In the reaction of an organic acid with a metal surface, the possibilities of forming polymeric products or associated products are more restricted by geometric or steric limitations and low diffusion rates than in the formation of soaps in bulk. There is no evidence for assuming that the same products always result. The surface roughness, the type of oxide, hydroxide or hydrated coating and its uniformity, and the action of the van der Waals cohesive forces in creating close packing of the hydrocarbon radicals in the adjacent acid molecules determine the porosity and thickness of the soap formed "in situ." Thus, the valency of the metal, the geometry of the adsorbing molecule, and the possibility that the metal atom reacted with the acid will no longer be bound to the metal lattice, may have a profound influence on the compactness, thickness, and permeability of the barrier film. Acids do vary greatly in their inhibiting properties [1, 2]. It is probable that the acids which react with the steel surface to form the least permeable and most effective inhibiting films are those least able to build up thicker soap deposits on the surface. The formation of soaps "in situ" is important in boundary lubrication also, and present knowledge has been summarized recently by Bowden and Tabor [24]. From the preceding discussion it is evident why the rust inhibitive and wear preventive properties of oils containing such additives are so closely related [3].

Since the soap of a metal when prepared in bulk is not a definite compound, it would be better to confine the use of the term "soap" to commercial products. Certainly, the new and difficult problem of studying the surface chemistry of the reaction of a metal with organic acids is being hindered by loose terminology. If the surface metal atom most involved is still bound to the metal lattice, it is difficult to discuss the reaction as the formation of the "soap"! When a soap formed in bulk is used as an oil additive to inhibit rusting, the acid released by it through hydrolysis or dissociation reacts with the immersed ferrous metal surfaces to form the barrier film responsible for the rust inhibition (and the

boundary lubrication). Due to the important contribution of the van der Waals energy of cohesion of the adsorbed molecules to the total energy of the adsorbed film [3, 20], the probability of the adsorption of the soap as such is small as compared with the adsorption of the related organic acid. How effectively the organic acid released acts to inhibit rusting depends on the nature of the soap formed "in situ" and the rate of release of the acid by the oil additive.

The logical choice for the soap additive to obtain maximum rust inhibition would be an acid of high molecular weight capable of adsorbing on the metal in the closest possible packing. But that choice leads to a soap additive which is difficultly soluble in the oil. The ability of the soap to associate with acid can be used to lessen this difficulty, for the association with excess acid can serve to increase the stability of the soap-in-oil-system. However, the acid getting ability of such a soap must be limited since some of the capacity to associate must be employed to disperse the rust inhibitor in the oil.

The soap rust inhibitor, like the amine-acid complex, acts as a reservoir of the inhibiting acid. It also ties up the unused organic acid thus helping to decrease the rate of corrosion of nonferrous metals. However, the soaps have the greater stability at high temperatures. They have two disadvantages: (a) the metal in the soap accelerates oxidation of the oil, and (b) where the oil can be charred or burned, as near valves of reciprocating engines, undesirable inorganic deposits may be formed.

VII. Improved Test Methods

Since our publication of the static, water-drop, corrosion test method [2], many laboratories have found it useful for both research and control. Five government laboratories have recently completed a cooperative testing program utilizing this method. After each operator had become familiar with the test technique and the proper way to examine and describe corrosion of the specimen, good reproducibility was obtained by the different laboratories. A comprehensive report on this test program will be presented elsewhere. In a recent symposium in England, Hoar and Smith [25] and McCue and Blane [26] each utilized a version of the static drop test method and obtained good reproducibility. The latter workers found an excellent correlation between the results of the static drop test and a shed storage test using a number of temporary corrosion preventives. Soon after our publication [2], static, water-drop test specimens were placed on the market by the Precision Scientific Company of Chicago.

In the fall of 1947 cooperative tests were conducted in the U. S. A. between 17 different commercial and Government laboratories utilizing the AN-H-31 specification humidity cabinet [27]. This program proved beyond a doubt the unreproducibility of the tests by any one laboratory and between the different laboratories. Clinton [28] has strenuously objected to the use of humidity cabinets which do not utilize a temperature cycle to insure condensation on the test panels. However, with this type of test as with the AN-H-31 humidity cabinet, the rate of condensation on the steel panels is critically controlled by the temperature of the cabinet, a slight variation in temperature resulting in a different rate of condensation and hence a different rate of leaching and rusting of the test specimens. Obviously, control of the rate at which water is deposited on the surface of the test specimen is extremely important, and there is inadequate control in all known humidity cabinets [2].

In the fog cabinet [2] however, the rate of condensation is controlled by mechanical adjustment of the atomizer for particle size and fog density. A carefully controlled volume of water is deposited per unit area of the test specimen in a constant temperature enclosure. The resulting test is reproducible. By adjustment of the controls accelerated corrosion conditions may be simulated. Since our description of the fog cabinet test method, a double window has been installed to allow examination of the test specimens thus avoiding the opening of the cabinet. This modification has been used successfully for three years. Increasing interest in this test is being shown by industrial and government laboratories.

VIII. Vapor-Type Inhibitors

During the first years of World War II the losses due to poor packaging of equipment for overseas shipment were appalling. In order to protect adequately war equipment exposed to rough handling and a wide range of climatic conditions, many excellent packaging materials and techniques were developed. Among these the application of the substituted ammonium nitrites [29] [30] [31] as vapor-type corrosion inhibitors has gained considerable prominence. Our earliest experiences with diisopropyl ammonium nitrite were in inhibiting the interiors of rocket bodies [32] and in developing aqueous hydraulic fluids which are inhibited against both liquid and vapor phase corrosion [33]. It was shown by Wolfe and Temple [34] [35] of our laboratory that this compound and also the diisobutyl and the dicyclohexyl ammonium nitrite could be prepared by a method which allowed manufacture of the crystalline product. In another investigation Baker [36] described a variety of applications and the limitations in packaging due to attack on some nonferrous metals.

These three nitrite compounds sublime readily at ordinary temperatures. They inhibit rusting by coating the exposed metal surface with an adsorbed film. A hydrophobic monolayer is formed on top of which there may deposit a loosely adhering coating of crystalline inhibitor. The film is hydrophobic with a contact angle of 55° for the diisopropyl and 50° for the dicyclohexyl ammonium nitrite at 20 C. This hydrophobic property is due to the polar-nonpolar structure of the substituted ammonium nitrite molecule. Because of the low molecular weight of the hydrocarbon portion of the organic nitrite molecule, prolonged contact with bulk water will result in solution of the protective coating; hence, rusting will occur. Desorption and solubility of the inhibitor in water are the causes of the limited vapor phase inhibition observed under conditions of extreme humidity.

When an aqueous solution of one of these substituted ammonium nitrites remains in contact with a clean iron surface preferential adsorption occurs, and the resulting film prevents the water from rusting the ferrous metal at 100 F. as long as the inhibitor concentration is at least 0.01% by weight. At higher temperatures higher concentrations of the inhibitor are required. However, if fresh water washes over the surface of the inhibited steel, it soon dissolves the adsorbed film and rusting slowly occurs.

The precise mechanism of rust inhibition is not fully understood. It is doubtful that the inhibition observed is entirely due to the hydrophobic film barrier in view of the low contact angle observed. The amine alone will inhibit in aqueous solution but not as efficiently as the ammonium nitrite, while in the vapor phase the amine is much less effective. It is interesting that $NaNO_2$ is approximately as effective as the ammonium nitrites as

a liquid phase inhibitor. It is concluded that these substituted ammonium nitrites are efficient inhibitors because of two cooperating properties: (1) they form readily adsorbed hydrophobic film barriers, and (2) the polar nitrite group in contact with the metal has a passivating action similar to that of $NaNO_2$.

These compounds may be applied to paper, cardboard, cloth, etc. The latter in turn are used to wrap metal articles or to line containers preparatory to packaging of equipment for storage or shipment [36]. Recent publications have described their uses in packaging ordnance material [37] and instruments and machinery [38]. These substituted ammonium nitrites accelerate the corrosion of zinc, cadmium, magnesium and lead in humid atmospheres, but not in the absence of water [36].

Other types of compounds have shown promise as volatile corrosion inhibitors. Schwoegler and Hutter [39] have shown that rust inhibition can be obtained by using a sodium, potassium or ammonium nitrite and an organic amide such as urea, acetamide, etc. A solution of these compounds may be absorbed in kraft paper, etc., which then releases vapors capable of preventing corosion. Vernon [40] described the use of sodium benzoate as a contact corrosion inhibitor and mentioned the possible uses of esters of benzoic acid as vapor-type inhibitors.

The introduction of these and more recent volatile corrosion inhibitors has created a new problem in the specification and testing of packaging and preservation materials. A laboratory test method for establishing the effectiveness of volatile type inhibitors is being developed by a task group of the Munition Board Packaging Committee.

IX. Conclusions

(1) It is concluded that both soaps and amine-acid complexes act as rust inhibitors in oils through the release of associated organic acid.

(2) The most effective rust inhibiting additives are those able: (a) to remain in the most highly dispersed colloidal condition, and (b) to supply the organic acid having the greatest ability to inhibit steel.

(3) The most effective acids are those forming iron soaps "in situ" which, because of the physical requirements for the production of effective barrier films, are believed to be chemi-adsorbed monolayers.

(4) No good evidence has been reported yet for concluding that soaps formed "in situ" are the same as soaps made in bulk and then added to the oil. Contrary to recent claims in the literature, there is no reason for believing that rust inhibitors adsorb as polymolecular films on steel.

(5) The relative merits and disadvantages of soaps and amine-acid complexes as rust inhibitors can now be outlined in terms of their relative acid associating tendencies, their reaction with nonferrous metals, and the effect of temperature.

(6) The ability of either soaps or amines to associate with carboxylic acids is discussed in relation to their uses for neutralizing acids in oils, acting as peptizers or coupling agents, and deterging acidic and insoluble oxidation products.

(7) Post-war experiences in various laboratories have shown the unsuitability of humidity cabinets for corrosion testing and the advantages of both the NRL fog cabinet and the static water-drop test methods for research and control.

(8) The effectiveness of the substituted ammonium nitrites as vapor-type inhibitors is due to their having two properties each of which independently causes rust inhibition, i. e., the ability of one end of the molecule to form a hydrophobic adsorbed monolayer (or water barrier), and the ability of the polar nitrite end of the molecule to inhibit steel through a passivation mechanism.

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THE MECHANISM OF GRINDING AND THE FUNCTION OF THE LUBRICANT*

by J. O. Outwater†
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dr. Outwater received his B.A. and M.A. degrees in the mechanical sciences from the University of Cambridge where he was awarded a Senior scholarship. He served with the Royal Electrical and Mechanical Engineers between 1943 and 1947 when he entered the Massachusetts Institute of Technology.
He was awarded the Timken Roller Bearing Fellowship and received his Sc. D. degree in 1950. His paper is based on work done under this Fellowship.
Dr. Outwater is now employed in the Engineering Department of E. I. du Pont de Nemours & Company.

ABSTRACT

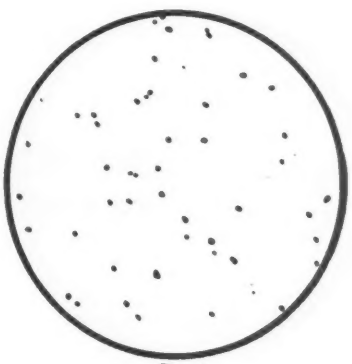
The behavior of single grains of abrasive in contact with the metal will be extended to show how the chemical reaction between the metal being ground and the atmosphere in which it is ground is a dominating factor in grinding. The lubricant will be shown to be effective only after the cutting has been done and that its effect on cooling the surface of the metal is negligible, its purpose being to prevent the bulk of the metal from overheating and to reduce the friction between the severed chip of metal and the bulk of the uncut metal.

Grinding is a peculiar process. It is a process that appears to differ fundamentally from all other metal cutting processes. If a piece of metal is cut on a lathe, it may be cut quickly or slowly depending on whether the lathe rotates quickly or slowly. This is not the case with grinding. If a grindstone is rotated rapidly against a piece of metal, the metal is removed and the wheel is untouched. If, on the other hand, the stone is rotated slowly, then the metal is not removed and the stone disintegrates. This behavior indicates that the process is not perhaps as obvious as it seems at first glance. If it were merely a case of the grits in the wheel acting as small cutting tools, then the metal would be removed at all speeds, and, indeed, would be removed with less damage to the wheel at low speeds than at high, as the cutting force exerted on the grits would be less.

In order to understand better the nature of the mechanism of grinding, it is first necessary to determine as carefully as possible exactly what happens when a grind-stone grit is in contact with the metal.

By rolling a carefully dressed grindstone across the surface of a piece of celluloid that has been moistened by a solvent, an impression as in Fig. 1, is obtained. This shows that the actual area of contact between the stone and the metal during grinding is very small indeed and the process might be considered more in the nature of a set of points clawing at the surface. It can be derived by calculation that the depth of penetration of these points is in the order of one hundred thousandth of an inch at normal grinding speeds and feeds. Bearing in mind these orders of magnitude, it may be considered that each grit is a small point acting on the metal and relatively distant from its neighbor. The influence of each might be very different from the effect of the stone as a whole.

The temperature between the grit and the metal being ground was found to be always near the temperature of the melting point of the metal. This was found to be a necessary condition, and, unless this was the temperature, the grits would be torn out of the grindstone.



Celluloid Impression of Surface of Grinding Wheel Actually in Contact with the Metal. 4X

Fig. 1

This finding showed conclusively that the conditions of temperature and pressure were extreme at the point of contact of the cutting edge and the metal. It might well be expected that some chemical reaction between the lubricant or atmosphere and the metal at the cutting surface was occurring.

This was exactly the case. A device was built to measure the actual force involved in grinding so that grinding efficiency could be determined and the entire test equipment was enclosed in a balloon through which different gases could be blown to form pure atmospheres. Many different gases and vapors were used. Air was used as the atmosphere and a standard depth of cut, wheel speed, table speed, and wheel width were used to give a standard comparison. The gases and vapors tried were air, steam, helium, nitrogen, benzene, alcohol, and carbon tetrachloride. The vapors were used in an inert atmosphere so that their effects could be isolated. The results were surprising. It was

† Currently affiliated with E. I. du Pont de Nemours & Co., Wilmington, Delaware.

* Paper presented at 6th Annual Meeting, ASLE, Philadelphia, April 17, 1951.

shown that when helium was used instead of air, and the system carefully purged of air, the force required was increased about twenty times over that required to grind in air. This was the same in the case of nitrogen and was unaffected by the introduction of either benzene or alcohol. Steam brought the force down to that of grinding in air. Carbon tetrachloride brought the force down, but not quite to that of air.

This information showed that the process was intimately connected with the atmosphere and that the air was a necessary part of grinding. How can this phenomenon be explained?

Fig. 2 shows an enlargement of the track of a single grit across the surface of metal taken at normal grinding speeds. It can be seen that along the sides of the track there is a distinct furrow thrown up. This furrow consists of the material that was previously in the track itself and must be ejected completely in order to remove metal in the process. Two things may happen to this furrow: subsequent grits may either break it off and eject it, or they may merely force it into the surface where it may reweld itself to the unground metal. If this latter is the case, then the same metal must be removed later if grinding is to proceed. The force expended to remove a certain volume of metal will then be proportional to the number of times that this furrow is thrown up, forced down, and recut and will therefore be dependent on the tendency of the metal to reweld on itself.

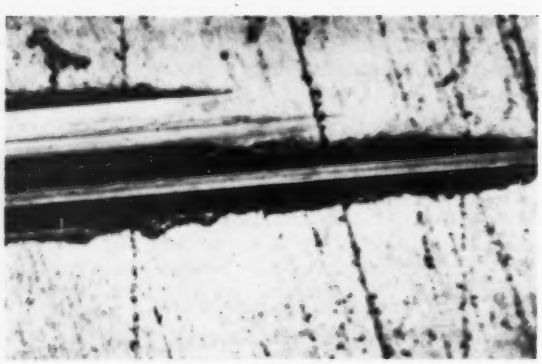


Fig. 2
The Path of a Single Grain in the Grinding of Steel. 25X

It is this tendency that appears to be controlled by the atmosphere in which the metal is ground. Oxygen appears to react instantly with the surface of freshly cut metal and form a thin layer of oxide on the surface which will inhibit rewelding. In the case of an inert atmosphere, this layer is missing, and the metal will be repeatedly cut, moved slightly forward under the action of the grits and welded before it is subsequently recut. A cross-section of the end of a piece of metal cut in an inert atmosphere is shown in Fig. 3 and the laminae of metal moved in each pass are readily discernible.

Carbon tetrachloride also reacts with the surface to form a layer, and, perhaps owing to this reaction not being as rapid as in the case of air, its effect may be less. Benzene is totally unreactive. Steam appears to oxidize the surface in a similar way to air.

The next series of experiments that were run were to determine the effect of lubricants on the process. Three different groups of lubricant were tried: water with a rust inhibitor, water with a soluble oil dissolved in it, and a straight grinding oil. Air was used as a standard for comparison. The results of this experiment showed that water-based lubricants—whether they contained a soluble oil or not — showed only slight improvement over air alone as far as force reduction was concerned. Straight oils were, however, most effective and reduced the forces to about 25% of those in air. It was shown also that with water-based lubricants the direction and pressure of application was significant, whereas with oils, the force remained at the same low level whether the oil was applied continuously, intermittently, or only a few drops every few minutes.

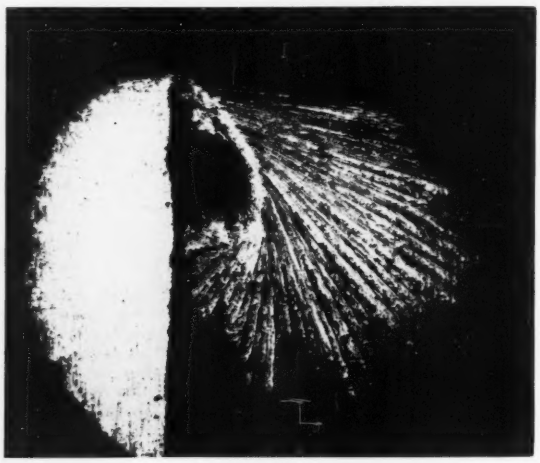


Fig. 3
The Profile of the Edge of a Piece of Metal Ground in an Inert Atmosphere. 25X

Since it is known the temperature between the grit and the metal being cut is always near the melting point of the metal, it can be assumed that the lubricant does not come between the stone and the metal while it is being cut. It appears therefore that the effect of the lubricant manifests itself at other than the actual operation of cutting.

In examining the effect of gases in the cutting operation, it was observed that a furrow was thrown up. This furrow cooled and hardened as soon as it was formed, and in the case of grinding in air, broke off and was ejected by following grits. Considerable friction developed between this broken off piece of metal and the bulk of the metal as well as with the grit, and it is this friction that the lubricant helps to reduce. As the pressures are high and the conditions for the production of a hydrodynamic film are unfavorable, it would appear that the most suitable lubricant would be the best boundary lubricant. This appears to be the result in practice. It is also confirmed by the fact that the quantity of lubricant applied is of secondary importance if the lubricant is effective.

Another purpose of the lubricant is to cool the metal. The heat generated in grinding at any given wheel speed will be directly proportional to the force exerted on the metal being cut. Thus it can be seen that the total amount of heat flowing to the metal will be greatly reduced if cutting oils are used. Since it is known the temperature of the actual points of contacts of the stone with the metal is near the melting point of the metal, this temperature cannot be reduced by the lubricant. It can also be shown mathematically that the rate of heat transfer from the point of cutting, through the metal and up through a film of liquid on the surface of the metal is much greater than that to a corresponding layer of air, indicating that heat would be trans-

(*Continued on page* 144)

COMMENTS ON

"The Main Ten Ends in Hydraulic Maintenance"*

EDITOR'S NOTE—The text presented below was received too late to include with the publication of Mr. Hayden's paper. We believe these comments add significantly to the value of the ideas expressed by Mr. Hayden. We offer them for your consideration.

Prepared by J. K. Douglas
Development Engineer
The Oilgear Company
Milwaukee 4, Wis.

Presented by C. Paneitz
District Engrg. Rep.
Detroit Office

"The Main Ten Ends in Hydraulic Maintenance," the paper presented by Mr. Hayden emphasizes many of the critical points in adequate maintenance procedures and should be helpful to most users of hydraulic equipment in aiding them in effectively reducing the cost of maintenance and consequences of break-downs.

You, who are users of hydraulic machines, can and should exercise your prerogative by specifying that machines be equipped with fluid power components which you *KNOW* will bring you the maximum returns on your investment. You can select a supplier who uses the desired hydraulic equipment or you can request your preferred manufacturer to incorporate specific units in his basic machine design. However, demands of this type are few and far between because alert manufacturers of quality machines are aware of most field malfunctions and usually take immediate steps to modify their equipment to protect their name and position in industry.

Don't you, as users, question the wisdom of aim No. 2—"STANDARDIZE ON ONE MAKE OF HYDRAULIC EQUIPMENT FOR ALL HYDRAULIC MACHINES IN YOUR PLANT"? No hydraulic equipment manufacturer produces units which are the ultimate for every application known to industry. No one concern has a monopoly on the science of hydraulics and, like other industries, no one concern ever will reach that utopia. Wise users know that only hydraulic units having the degree of dependability warranted by the importance of their work will bring the most profitable returns.

Each hydraulic equipment manufacturer specializes in certain types of equipment and, while some may overlap those of other manufacturers to some degree, usually each manufacturer excels in some specific field and can offer equipment which is better adapted to that field than other equipment. It is largely this fact which keeps so many hydraulic equipment manufacturers in business. If an entire plant were limited to the use of hydraulic equipment furnished by a single manufacturer, the advantages that could be obtained by using equipment made by other manufacturers who specialize in a certain line would automatically be sacrificed.

Standardization is strongly recommended but standardization should be based on obtaining the best performance available from a minimum number of varieties of units. Some varieties may be furnished by one manufacturer and some varieties by another, but if you try to base your selection of hydraulic equipment in accordance with the name of a manufacturer rather than the quality and performance of the equipment in each specific field, you sacrifice the cream of modern development progress.

To standardize on one make of hydraulic equipment for all hydraulic machines in your plant would retard progress in the development and improvement of such machines and in some cases would limit you to the use of inferior equipment. Instead of possibly reducing your maintenance problems, you multiply them. Buy the best equipment on the market for your specific application, be sure it's sturdy enough to stand the rough treatment which most industrial equipment often gets and you have made the most important step towards reducing your maintenance costs and problems. Yes, on certain complex applications, you will find it advantageous to combine components of two or more suppliers to obtain the optimum of performance and durability.

Make your selection on the basis of quality rather than on the standardization of one make of hydraulic equipment. Select units which give the best performance. Select the most simplified oil circuit. For better housekeeping, absence of annoying leaks, lower oil bills and less maintenance, be sure the number of auxiliary components and associate piping and fittings are reduced to a minimum. Installations reaching Christmas-tree-trimming proportions have given rise to a lot of confusion in the hydraulic industry.

As for aim No. 3, "MAINTAIN A STOCK OF SPARE HYDRAULIC UNITS AND PARTS," it should be received and executed with reservation. Of all mediums used for power transmission purposes, fluid power offers the maximum life and minimum amount of replacement needs. Do not place hydraulic units which "deal" in oil and bathe and work in oil in the same category with mechanical components which depend upon the daily faithfulness of the maintenance staff and are exposed to varying elements. If tried and proven hydraulic components, sturdy enough for the applications have been installed and are reasonably well cared for, there should be no need of an extensive inventory of spare units or parts. In some of the large plants where duplicate units are used in large numbers, a limited stock of spare units or parts might prove practical and represent only a small fraction of the hydraulic equipment investment. Remember, dormant spare units and parts must be carefully stored and periodically inspected lest acid or oxidation action impair the close working fits. Continuous service of hydraulic units for five years or more is not exceptional. Many have performed for a score of years with nothing but the average attention. Less than two weeks ago, a user

(*Continued on page* 142)

* Paper presented at 5th Annual Meeting of ASLE, Detroit, April 11, 1950. Published in Vol. 6 - No. 6 (December, 1950) issue of LUBRICATION ENGINEERING.

CONVENTION HI-LITES

ASLE HEARS PRENTIS

The guest speaker at our recent banquet in Philadelphia was Mr. Henning W. Prentis, Jr., Chairman of the Board of the Armstrong Cork Company and one of the nation's outstanding industrial and civic leaders.

Mr. Prentis emphasized the necessity for closer relationship between engineering societies and our industrial economy. He urged greater cooperation between Government and business, especially in view of the existing worldwide economic crisis.

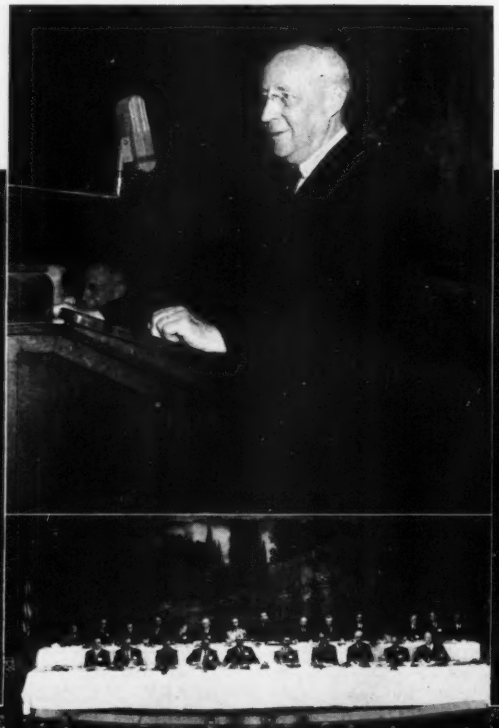
We were fortunate to hear such an inspiring and thought provoking message.

HENNING W. PRENTIS

ASLE ANNUAL AWARD

The ASLE Annual Award signifying life membership in the Society for the individual contributing most to the furtherance of the science and practice of lubrication was presented to Mayo D. Hersey of the Engineering Experimental Station at Annapolis, Maryland. Mr. Hersey has enjoyed a long and distinguished career and has been accorded many honors from technical societies and universities. His outstanding work in the fields of viscosity, friction and lubrication in general has served as a basis for many of our proven theories of today.

MAYO D. HERSEY

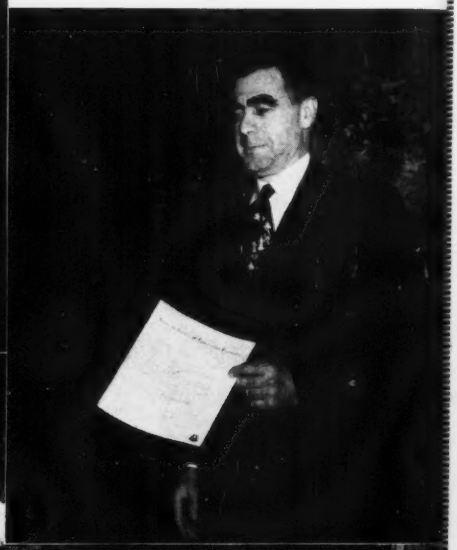


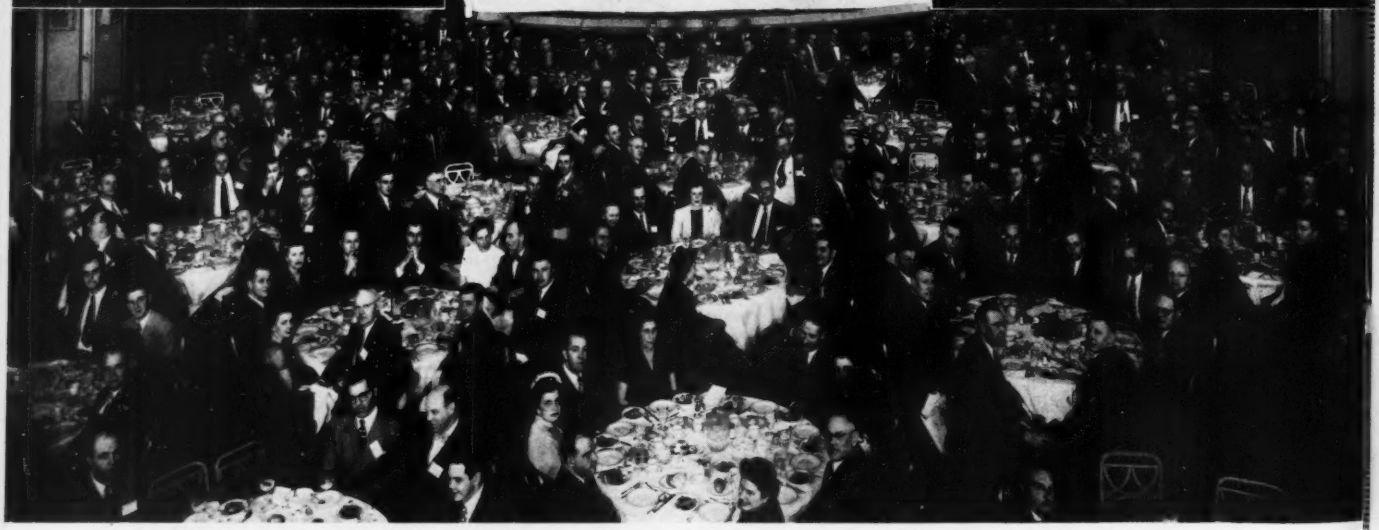
ANNUAL HUNT AWARD

The Captain Alfred E. Hunt Memorial Medal established in commemoration of the memory of Alfred E. Hunt, one of the founders of The Aluminum Company of America, was awarded to K. L. Hollister of The Texas Co., for the best paper on the subject of lubrication offered during the year.

Mr. Hollister's paper entitled "Compressor Lubrication" is an outstanding contribution to the existing knowledge on this subject. The article was originally published in the August 1950 issue of LUBRICATION ENGINEERING.

K. L. HOLLISTER





SIXTH ASLE BANQUET, HOTEL BELLEVUE-STRATFORD, PHILADELPHIA, APRIL 17, 1951

SAGINAW VALLEY

We are happy to announce the formation of another new Section of ASLE. The following report is indicative of a fast-growing organization which will add materially to the strength and prestige of our Society as a whole.

By Don W. Benner, Chairman

Representatives from leading industrial concerns in Flint, Saginaw, Bay City, Midland, and Owosso met in Frankenmuth, Michigan, March 29th, 1951, for the purpose of organizing a Saginaw Valley Section.

The National Secretary, W. F. Leonard, arrived in Frankenmuth to inform the assembled group of the aims, purposes and future plans of the Society. He reviewed some of the accomplishments of ASLE and delighted everyone with a brief talk on lubrication principles. A unanimous vote responded to Mr. Leonard's motion that a local section be established, and by an equally unanimous vote the following officers were elected:

Chairman—Don W. Brenner, Lincoln Engineering Co., Detroit, Mich.

Secretary—Dwight Buell, Shell Oil Co., Saginaw, Mich.

Treasurer—Sterling Kimball, A.C. Spark Plug Co., Flint, Mich.

The new chairman officiated for the balance of the meeting during which certain prime organizational matters were discussed. Mr. Benner introduced a visiting delegation from the Detroit Section consisting of their Chairman, Ed Kelly of Budd Wheel Co.; Vice Chairman Morgan Lawton of the Lincoln Engineering Co., and their Secretary, Jack Swain of Mergraf Oil Co. Each spoke a word of advice and encouragement —and challenged the Saginaw Valley Section to a soft ball game.

From the attendance at this first meeting, the interest shown and the spirit manifested by everyone, we are sure there will be a very successful Section in the Saginaw Valley of Michigan.

YOUNGSTOWN

By J. P. Halwachs, Secretary

At the April meeting of this Section two films were presented: "Fishin' For Fun," produced by Fisher Body Div. of Gen. Motors, and "Football Parade of 1950," by Jack McPhee of The Ironsides Co. Members and guests were entertained by Jack's usual excellent discourse on football highlights. His talk was spiced with his many experiences as a football official.

Chairman C. M. Winn announced acceptance of this Section's application for membership in the Mahoning Valley Technical Societies Council, which is composed of representatives from nine technical societies in the Mahoning Valley.

"Diesel Lubrication, Fuels and Maintenance," by E. B. Nugent, Manager Sales Engineering, Sun Oil Co.—May meeting.

A blackboard presentation accompanied Dr. Nugent's discussion, which included the course Diesel lubricating oils have taken over the past twenty years—from the days of the Non-Additive type through the range of Oxidation Inhibited lubricating oil, the Detergent, MIL-0-2104, Supplemental or Series 1 and 2 types.

Dr. Nugent stated, "Great emphasis is being placed upon the function of oil to reduce the wear factor in internal combustion engines. While the public is becoming increasingly conscious of the necessity of preserving their engines for longer periods of time every means is being taken to assist the average engine owner to obtain longer life from his equipment.

"The causes of engine wear have always been present to some degree, but the shortage of critical materials, the fuel situation and the demands of the motoring public have accelerated the causes of engine wear. Both the engine designers and the oil chemists have joined in exhaustive research to eliminate as much as possible, engine deterioration. Newer oils and newer piston rings as well as new theories of thermo-dynamics have done much to assure the average engine owner that he can expect more horsepower life from today's engines than at any other time in the history of the industry.

"The only problem which remains is to educate the average engine operator to a point where the earliest signs can be diagnosed and the engine ailments remedied before serious injury occurs. Both the engine builders and oil companies are, through educational publicity, endeavoring to do this."

DAYTON

By V. C. Hutton, Secretary

Dr. E. M. Kipp, Executive Secretary of Central Lubrication Committee of Aluminum Company of America, told of the functioning of his Committee, of the Plant Shop Lubrication Committee and of the research work being done by his department.

In discussing the Central Committee, Dr. Kipp stated that this Committee establishes policies concerning the lubrication program and determines the projects on which work is to be done. Members are as follows:

Ass't General Purchasing Agent
Chief Engineer
Chief Metallurgist
Chief Metallurgist of Casting and Forging Division
Chief Metallurgist of Mining Division
Manager of Fabrication Committee
Executive Secretary of Committee

In addition to the Central Committee, each plant has its own Plant Shop Committee which has among its members, the Chief Metallurgist and Chief Purchasing Agent of the Plant.

Attention was called to the method of evaluating stability of lubricants. A number of oxidation test methods are used and from the accumulated results obtained, the lubricants are classified into one of three groups. In evaluating gear oils, five different machines, including the Timken, the Falex and the Shell Four Ball are used. By assigning factors to the results obtained from each machine an accumulative rating is obtained.

Dr. Kipp showed pictures of the Lubricants Laboratory and some of the equipment and stated that the staff consists of twenty-two people and the annual budget for research is $200,000.—March meeting.

MILWAUKEE

"Fretting Corrosion," by R. S. Barnett, Ass't Supervisor of the Products Application Dept., The Texas Co., Beacon, N. Y.

One of Mr. Barnett's major assignments has been Fretting Corrosion and he is exceptionally well versed on the subject as is evident by his papers and lectures pertaining to it.

Fretting corrosion is one technical problem associated with lubricants and lubrication that is still only partially solved; it is also known as false brinelling or friction oxidation. This is a particular type of metal corrosion or oxidation which occurs on the contact areas of loaded metal surfaces subject to oscillatory or vibrating motion.

CINCINNATI

By W. D. Whalen, Chairman
Section News Committee

"Cutting Oil and Coolants," by C. B. Harding, Research Technician, Sun Oil Co.—March meeting.

There are basic fundamentals to be considered for the successful performance of a cutting fluid:

1. Lubrication between chip and tool, and between tool and work.
2. Cooling effect on tool and work.
3. Removing chips.

There are two basic types of cutting fluids:

1. Emulsifying type.
2. Non-emulsifying type.

The emulsifying types are mixed with water in various percentages depending on the type of operation. They are generally divided into two classifications: Regular and Heavy Duty. The Regular is used for light grinding and machining operations, the Heavy Duty group for heavy machining operations.

The emulsions are only as good as the water from which they are made. The emulsions are the best heat transfer agents.

The non-emulsifying types are compounded oils. They may be made from petroleum, mineral, animal, vegetable or fish oils or combinations of these compounded with fatty acids, chlorine, sulphur, etc., to obtain the desired properties for various applications.

"Gear Lubrication," by L. J. Collins, Gear Engineer, General Electric Corp.—May meeting.

Mr. Collins discussed in detail:

A. The purpose of a lubricant.
B. The importance of surface finish on gear teeth.
C. Characteristics of a gear that would operate without lubrication.

All machined surfaces are made up of hills and dales. The finer the surface finish, the smaller the hills and dales. If two machined surfaces are in contact and it is desired to move one with respect to the other, interference between the hills on the two surfaces makes it necessary to apply a force to produce motion. The force applied must be of sufficient magnitude to shear off the hills. This results in heat being generated.

It is the purpose of the lubricant to fill the dales and separate the surfaces with an oil film which has a much lower shearing force than the metal, thereby greatly reducing the force required for motion.

Three factors determine whether an oil film can be maintained between gear teeth in operation:

A. Rubbing velocity of the teeth.
B. Surface finish.
C. Oil viscosity.

BALTIMORE

By A. E. Cichelli, Chairman
Program and Meetings Committee

"Synthetic Lubricants," by Dr. W. H. Millett, Linde Air Products Co. —January meeting.

Dr. Millett traced the developments of synthetic lubricants and elaborated on their properties and uses. He covered the silicones, diesters, phosphate-esters, halogenated hydro carbons and the poly-alkalene glycols. It was on the latter type that he spent most of his time referring to recent developments which included the formulation of a series of greases that incorporate the desirable features of the base liquids and the preparation of a new series of fluids having viscosity indices ranging from 160 to 180. Data from laboratory bench wear tests, performance tests in hydraulic equipment, and industrial and automotive gear installations were presented which indicated that the poly-alkalene glycol lubricants are characterized by excellent wear resistance.

"The Design, Application and Maintenance of Tapered Roller Bearings," by S. M. Weckstein, Ch. Engr., Ind. Div., The Timken Roller Bearing Co.—February meeting.

The author discussed and illustrated with slides all types of roller bearing design and applications. Stress was placed on the necessity for proper coordination between the machine designer, equipment manufacturer, equipment operator and the lubricant refiner. Since each application is an individual problem, correct design and cooperation of the four groups is essential to a proper solution.

"Bentone Greases," by D. H. Compondu, Warren Refining and Chemical Co.—March meeting.

Bentone Greases had their inception approximately ten years ago at the Mellon Institute for Industrial Research; the National Lead Co., through fellowships, developed the various Bentones which are now available to the lubrication grease manufacturers. The principal properties of these greases lie in the fact that they do not melt like the conventional soap type and it is claimed they will lubricate efficiently up to the flash point of the base oil used in their manufacture.

"Lubrication of Pumps and Compressors," by C. T. Chapman, Manager, Ingersoll Rand Co. — April meeting.

Quoting the author, "The object of this paper is to call attention to the different types of compressors used today, give a brief description of the systems of lubrication generally used, and the oils recommended for each different system. Particular attention is called to temperature problems involved, oil quantities to be used, and the consequences of using improper oils. Slides illustrate points of interest, and an effort is made to indicate many extraneous problems that enter into the lubrication of a compressor."

Upon conclusion of his talk, Mr. Chapman submitted a recent specification chart drawn up by his company based on experiences in the field, in the lubrication of any size compressor under any condition of operation.

BOSTON

By A. S. McNeilly, Secretary

"Operational Factors Affecting Engine Lubricants," by J. Fahey of PMS Inc.—March meeting.

Preventive maintenance, in many cases, is beyond control of the operator such as design, environment and terrain but today these factors can be predicted and controlled to assist the operators. Standard maintenance, standard lubrication and controlled lubrication and service of automotive and industrial equipment were discussed.

The two points stressed, were improper combustion of fuels, and abrasives present, as the cause of poor performance, heavy cost and maintenance time. As a means of improvement we quote from the author:

"Since operators cannot change driving habits, we must look at the engine for ways and means of improvement:

"1. We strongly recommend proper maintenance of fuel and ignition systems as herein lies the major cause of oil contamination.

"2. Since blow-by contamination is greatest during idling and low speeds, modifications are necessary to increase air velocity through the crankcase at these critical periods.

"3. Not enough thought or significance is given to thermostats and their importance. Higher-range thermostats in the range of 160 F. to 180 F. will maintain

higher overall engine temperatures and are desirable in many operations even though they require the use of non-volatile anti-freeze in the winter.

"4. Thermostats will maintain adequate upper engine temperatures but the cylinder jackets of many engines are still overcooled due to excessive coolant capacity at light loads and in cold weather. Improved jacket temperature control is thus another important problem requiring further attention. Considerable work is being done in this regard with some very good results such as:

a. reversed cooling;
b. insulation of crankcase;
c. heated oil filters, etc.

"5. Oil filters assist in prolonging oil life by removing dirt, dust, and insoluble blow-by contaminants from the oil as it circulates. They cannot, however, remove *soluble* blow-by contaminants from the oil, such as dilution, moisture, fuel resins, and do not affect precipitated contaminants within the engine. Filter servicing demands depend upon the individual engine and its own operation.

"6. Frequent oil changes are sometimes adopted to minimize engine sludging troubles. Oil changes at intervals as predicted by the particular engine operating conditions are recommended as a means of flushing out accumulated blow-by solids and contaminants to aid in keeping deposits at a minimum. Under many conditions of service, the change practice would have to be so frequent that it would be entirely too costly in time and lubricants.

"7. The use of detergent-type heavy duty oils has been widely publicized with the idea in mind of preventing cold engine troubles. Detergent additives have a limited capacity for holding blow-by insolubles and contaminants in dispersion in the oil. When oils become contaminated with several per cent and more of blow-by products, detergents become hopelessly overloaded. Regardless of whether these contaminants are held in dispersion or not the oil cannot be considered a good engine lubricant.

"In addition to the oil being a lubricant, it must also serve as a catch-all in this case of blow-by contaminants which work past the pistons into the crankcase. It appears that more general recognition must be given to the fact that oil alone cannot cure engine sludge problems; that some measure of assistance must be given in the way of maintenance and design modification."

ST. LOUIS

By O. Wulfert, Chairman

"The Alloys of Engine Lubricating Oils," by C. G. Rosen, Consulting Engineer, The Caterpillar Tractor Co.—April meeting.

Mr. Rosen has been connected with the design and manufacture of diesel engines since 1915 in engineering, manufacturing, U. S. Army and Navy activities, universities, in private consulting practice and with the oil companies. This experience has extended throughout this country and Europe.

The following are representative of the items discussed:

In order to use the most economical fuel, tests are being conducted in Europe using a low-grade fuel heated to 180 C. before injection into the cylinder. This provides a very clean and economical engine and prevents contamination of the lubricant.

Even though advanced designs are being developed in Europe the best lubricating oils are available only from U. S. refineries. At the present time, refineries are being built all over Europe and in the future they will make their own.

The Caterpillar Company uses a surfide process to coat the cylinder walls, rings and pistons as a lubricant in the wearing-in process. Engines are run for two hour's time from idle to full load and are then ready for maximum performance by the customer.

The liners used in diesel engines are induction hardened.

Ceramic liners have shown some advantages, particularly a long life. It has been found necessary to use a shrink fit steel jacket to keep the Ceramic liner under tension in order to prevent chipping due to expansion or contraction.

Due to treaty restrictions the Germans are restricted to a tonnage suitable for coastwise passenger and cargo ships. By building a combination passenger and cargo ship using three propeller shafts with four diesel engines to each shaft they have designed a vessel under the treaty restrictions which permits transoceanic travel. The engines are low in weight allowing extra cargo space. Several spare engines are carried on board and additional engines are kept at each end of the trip permitting easy removal for servicing.

The jet aircraft engines built in this country were developed from British designs. Of twelve possible general designs of jet engines they have had sufficient funds to develop only two and all their skill and engineering has been concentrated on these two designs.

Lubrication test procedures and quality standards for crankcase oil were discussed.

"Resumé of Lubricant Tests—Their Meanings, Interpretations and Relationship to Usage," by H. L. Hemingway, Product Manager of Marketing Div., Pure Oil Co.—April meeting.

Mr. Hemingway, in basing his remarks on eighteen years' experience in the petroleum industry, illustrated the pitfalls into which organizations fall in preparing specifications of lubricants predicated upon laboratory tests which have little or no correlation to field results. In discussing the subject in relation to new oils the tests were divided into three categories:

1. Those of limited significance.
2. Those having no significance.
3. (and most important)—those having performance significance.

The speaker brought out the fact that many of the tests are made in a vessel having a small diameter compared to those in actual field use and therefore field performance may vary from laboratory analysis. Often, tests for foaming have been taken from the foam level rather than from the oil level. Precipitation number while more important to fuel oil is of value in relation to lubricating oils as a quick and easy method of testing for dirt.

Mr. Hemingway covered very ably the balance of the tests and gave their significance to actual performance.

In concluding and in the discussion period following, he emphasized that his remarks were directed to new oil specifications and that all oil figures be made to include some sort of performance test.

FORT WAYNE

By J. W. Buckner, Chairman

"Multi-Purpose Grease," by J. G. Fuller, Indiana Div. Mgr. of Industrial Products of Shell Oil Company. —March meeting.

The talk covered the present trend toward a multi-purpose grease which will eliminate the many different types now in use and standardize on

(*Continued on page* 141)

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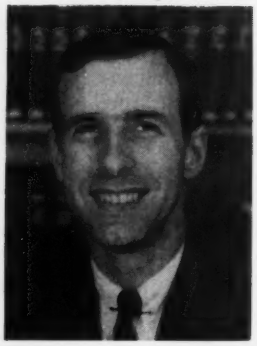

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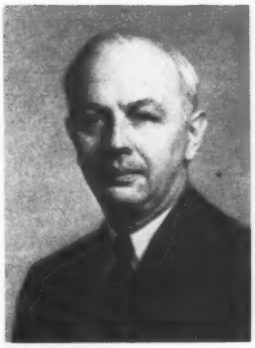

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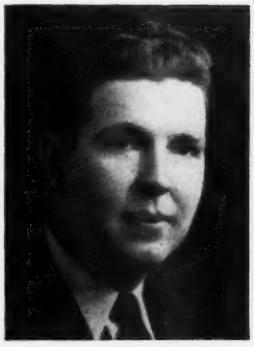

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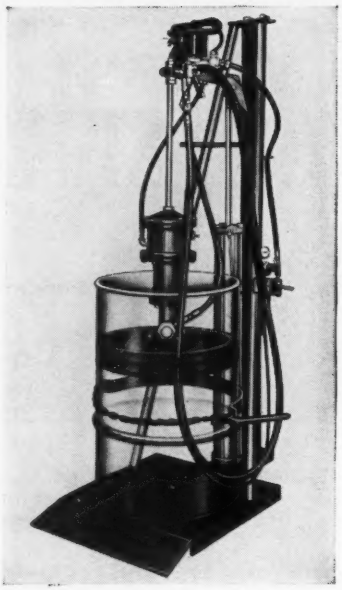
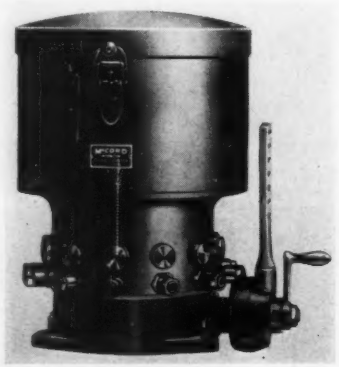
LUBRICATION IN THE NEWS



FORCED INDUCTION PUMP: For delivery of heavy lubricants which will not readily seek their own level, a hydraulically-operated, single Air Ram Elevator has been developed. Used in conjunction with the heavy duty DeLux air-motor operated drum pumps, a pressure of 7110 pounds is claimed by the manufacturer. It will completely empty and clean the sides of a 400-pound or 55-gallon drum. For full details write for Bulletin 678.

Lincoln Engineering Company
5743 Natural Bridge Ave., St. Louis 20, Mo.



GREASE LUBRICATOR: Type "F" Lubricator is simple in design and of strong construction. There are no valves, spring or packings and it is said to function in the coldest weather and with all kinds of standard lubricating grease. It is claimed the quantity of grease to be delivered is accurately controlled regardless of pressure. Reservoir capacities of 4, 8 and 16 quarts are available with from 1 to 24 outlets along with rotary or ratchet drives. Detailed drawings and application information will be forwarded upon request.

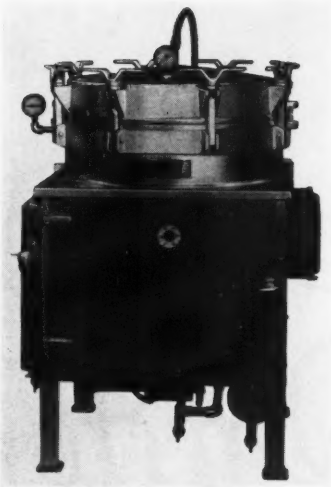
McCord Corporation
Detroit 11, Mich.

OIL COOLER: The manufacturer claims that predetermined temperatures can be maintained and controlled through the use of the WILL-COOL OIL COOLER. It is particularly adapted for the control of cutting oils and hydraulic fluids. The cooler is designed for quick inspection of its few parts and readily accessible for cleaning without the necessity of disconnecting refrigerant or oil lines. Bulletin available upon writing the manufacturer.

B. S. Williams Co., Inc.
6 North Street, Mt. Vernon, N. Y.

RUST INHIBITOR: An oil-soluble rust inhibitor which is said to protect metals from corrosion 10 to 15 times longer than previous formulations is now available. ALOX L-1673 oil blends are said to have among their many uses, qualities for protecting metals or equipment during fabrication and/or storage. A technical bulletin covering properties, performance data and blending procedure can be had by writing the manufacturer.

Alox Corporation
3948 Buffalo Avenue, Niagara Falls, N. Y.



OIL RECLAIMERS: Now in production and in service. The redesigned units feature improved design including rotary type pumps and new vacuum pump lubricating systems. Fewer shutdowns and longer equipment life are claimed to be the result of the use of these new units. The reclaimers are being used in diesel and gas engines and compressors, vacuum pump lubricating and sealing oils, hydraulic and industrial oils. Operation continuous and automatic, available in capacities ranging from 2 gallons to 500 gallons per hour. For further information write the manufacturer.

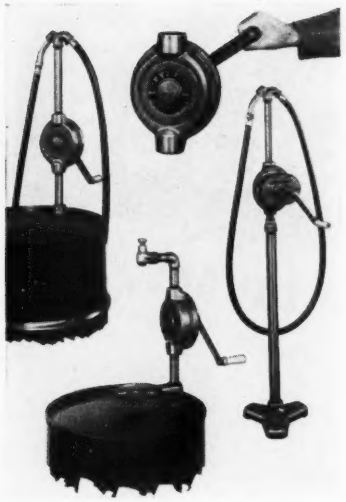
The Hilliard Corporation
Elmira, New York

MECHANICAL SEAL: Type 9 Mechanical Shaft Seal, recently designed, is said to perform effectively under severe temperature and corrosive conditions. It incorporates a flexible ring molded from the new plastic, Teflon. The Teflon "wedge-ring" enables this seal to combine the chemically-inert properties of Teflon with the flexibility and positive sealing components essential to effective mechanical sealing. Designed for service on various rotating shaft applications, it is said to be applicable for temperatures up to 500 F.

Crane Packing Company, Dept. F-14
1800 Cuyler Ave., Chicago 13, Ill.

NEW DISTRIBUTOR: Bruns & Collins, Inc., Chicago, specialists in the sale of automotive equipment, have been appointed direct factory distributors for Aro Equipment Corp., covering lubrication equipment in the northern Illinois territory.

Aro Equipment Corporation
Bryan, Ohio



HAND PUMPS: This line known as Series 210, 404, 414, 828 and 807, is available in models as pump only; or equipped with: suction and delivery pipe for drums and skid tanks —return drip pan for barrel mounting—refueling hose and nozzle—floor stand for underground tanks—brackets for wall or foot mounting—locking device—and changes of accessories for most combinations of the above models. New literature picturing the line is available upon request from the manufacturer.

Blackmer Pump Company
1809 Century Ave., Grand Rapids, Mich.

OILERS: "Helping To Make The World Run Smoother" — just released. This booklet traces the development of the oiler back to its earliest known origin and shows its evolution through old patents up to the modern oiler. Practical information on the various types of oilers, their applications and the kinds of oils to use for various purposes is given. Copies of the bulletin are available upon request to the manufacturer.

Eagle Manufacturing Company
Wellsburg, W. Va.

TOP OILER: No. 3000, Model B, a redesigned Universal Top Oiler, features numerous improvements including a new type intake manifold fitting which provides a better method of admitting top oil into the manifold. The oiler is a metering device which distributes top oil to all cylinders in a gasoline engine overcoming the uncertainty of top cylinder lubrication when oil is introduced into the fuel tank.

Universal Lubricating Systems, Inc.
690 Allegheny Ave., Oakmont, Pa.

"SINCLAIR PLAN:" In an endeavor to meet the need, which has been steadily increasing and is now approaching peak proportions, for new products and new applications, this company has opened a part of their research laboratories for the reception of American inventiveness. Mr. P. C. Spencer, President, in commenting upon this recent move, states, "It is the intention of the Laboratories to seek out these people with ideas." All the necessary facilities and skilled personnel will be made available to any American with an accepted idea. The Laboratories have extensive facilities for research, development and pilot plant testing of all ideas relating to petroleum and petroleum products.

Sinclair Oil Corporation
630 Fifth Ave., New York York 20, N. Y.

TAP LUBRICATOR: Adaptable for multiple tapping operations, this lubricator is claimed to offer an effective method of keeping the taps cool and free from chips. It is operated by means of a cam attachment controlling the spray which reaches all taps simultaneously furnishing an oil film and at the same time removing all chips by air pressure.

Beckett-Harcum Company, Inc.
1140 Wayne Road, Wilmington, Ohio

LUBRICATING GREASE: "Kantmelt"—for use on either plain or antifriction bearings where both "cling" and lubricity of the lubricant should be maintained at high operating temperatures. It is a synthetic grease containing no metallic soaps, fatty acids, filler, water or alkali. It is claimed to be stable under all conditions of service and storage. A sample for test purposes is available to any organization requesting it on their letterhead.

Specialty Products Company
190 Warren St., Jersey City 2, N. J.

MOLYBDENUM DISULFIDE: Announcement is made of a new booklet on Molybdenum Disulfide as a lubricant which contains excerpts from technical papers on this subject by outstanding authorities in the field. The booklet is illustrated with graphs and charts explaining the chemical action of Molybdenum Disulfide.

Climax Molybdenum Company
500 Fifth Ave., New York 18, N.Y.

SPRAY LUBRICATION: The Mechanical Conveyor Lubricator consists of a timing mechanism and spray head mounted at a desirable location on the conveyor in connection with the automatic spray lubricator. It is said to be especially valuable for conveyor systems that pass through baking ovens as it can be mounted so that the conveyor rollers are sprayed with a protective coating of oil immediately after leaving the oven. The manufacturer claims that oil drippage has been completely eliminated and oil consumption drastically reduced.

Manzel, Inc.
315 Babcock St., Buffalo 10, N. Y.

FRONT COVER

DETROIT

By J. W. Swain, Vice Chairman

The Detroit Section of ASLE with other affiliate societies of the Engineering Society of Detroit, will take a leading part in the 250th Birthday Festival of the city.

This celebration will begin July 24, 1951 with an historical pageant depicting the founding of the city by Cadillac in 1701. A parade with non-commercial historical floats will proceed to the State Fair Grounds. Here will be exhibits showing Detroit and Michigan's contributions to everyday living.

Since so much of Detroit's progress and growth has centered around science and industry, the Affiliate Council of the Engineering Society of Detroit is acting as the Science and Engineering Committee of the Festival.

Arrangements have been made for industry open houses which will include plants of the lubrication industry in the area.

The Detroit Section, along with other technical groups has planned an exhibit for the Engineering Society's Rackham Building and plans to participate in radio and television activities.

Ed. Note—We desire to comment on this Section's alertness and cooperative spirit in taking advantage of the opportunity to further the interests of industry, thus fulfilling the basic intent in the formation of ASLE.

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Four Companies Rolling Aluminum First Ordered	448
Subsequent Orders by these Same Companies	618
TOTAL MORGOILS PURCHASED FOR ALUMINUM MILLS	4,343
	3,032

Number of MORGOILS in Use on 2-High Mills	19
Number of MORGOILS in Use on 4-High Mills	31
Number of 4-High Tandem Hot Mills Using MORGOILS	7
Number of 4-High Tandem Cold Mills Using MORGOILS	40
Number of 4-High Reversing Hot Mills Using MORGOILS	
Number of 4-High Reversing Cold Mills Using MORGOILS	
Number of MORGOILS Used on 2-High and 4-High Aluminum Foil Mills	388

3,783 MORGOILS Have Been Purchased for use in the United States

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We would like to receive your inquiries for the installation of MORGOIL Bearings in new or existing mills of all types.

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International Construction Co.
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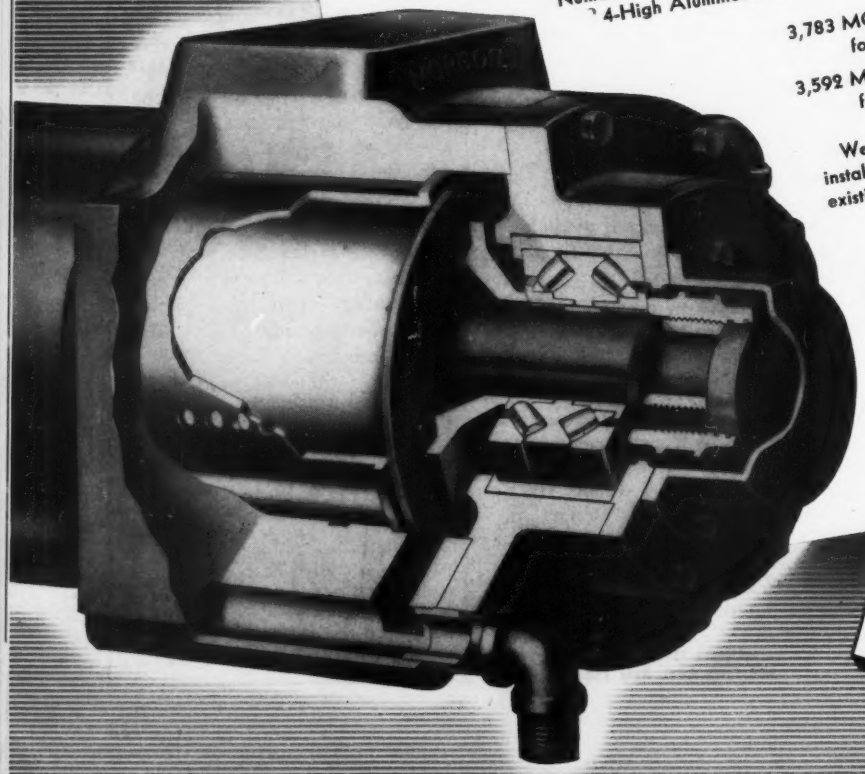

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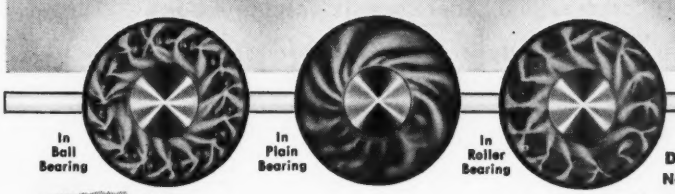
AUTOMATIC LUBRICATION SYSTEM

Unbelievably simple system atomizes oil into mist, distributes it through tubing to bearings. Bathes all bearing surfaces with fresh, clean, cool oil film. Uniformly maintains oil film on all sliding, rubbing, rolling parts regardless of variations in load, temperature or speed. No "peaks and valleys" of lubrication.

Fully automatic—eliminates waste and the uncertainties of the "human element." Extends bearing life as much as 17½ times. Seals bearings against dirt and abrasives. Cuts oil consumption as much as 90%. Greatly reduces the number of oils needed.

Eleven points on this automatic electric saw are served by Oil-Mist. Flexible lines carry lubricant to reciprocating and oscillating parts . . . condensing fittings apply liquid oil to a cam and roller . . . a spray fitting sprays oil on a drive chain, gear and sprocket. The lubricator is controlled automatically by the machine switch.



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CURRENT LITERATURE

Aeronautical Engineering Review, Vol. 10, No. 3, March, 1951

OBSERVATION OF THE LUBRICATING OIL FILM BETWEEN PISTON RING AND CYLINDER OF A RUNNING ENGINE; THE EFFECTS OF RING GEOMETRY

Brooks, R. L. and Atkin, M. L.—p. 61

(Australia, Department of Supply and Development, Aeronautical Research Laboratories, Report No. E.66, May, 1950, 21 pp.)

A qualitative method of studying the oil film involved measuring the electrical contact resistance between the top piston ring and cylinder wall of a running engine.

SUMMARIZED PROCEEDINGS OF A CONFERENCE ON THE PHYSICS OF LUBRICATION, MANCHESTER, 1950

Anon.—p. 61
(British Journal of Applied Physics, Vol. 1, No. 11, November, 1950, pp. 275-285

A bibliography is included.

Chemical Engineering, Vol. 58, No. 3, March, 1951

LUBRICATION CHEMICALS AND TEXTILES

Witt, T. R.—pp. 252-253

The arrangement used in the Tennessee Eastman Corp. to lubricate both chemical and textile equipment used in making cellulose acetate yarns is described.

LUBRICATION . . . 3 BROAD PHASES

Hollingsworth, D. F.—pp. 255-257

Suitable lubricants should be provided for each piece of equipment, correct guides should be purchased, and application should be in correct quantities and at proper intervals.

Diesel Power and Diesel Transportation, Vol. 29, No. 2, February, 1951

REVIEWING THE PRINCIPLES OF CENTRIFUGAL PURIFICATION

Reed, K. D.—pp. 60-62

The present day centrifuge bowl is known as the "balanced column" type bowl and the accompanying illustrations graphically portray the principle. The application of centrifuges to reclaim lubricants is considered.

Journal of Commerce, Vol. 228, No. 17, 368, April 6, 1951

NEW RESEARCH COMPANY FORMED BY SINCLAIR OIL

Anon.—p. 15

Sinclair Oil Corp. announced it has formed a new wholly-owned subsidiary to take over all research activities of the Sinclair companies, including the laboratories at Harvey, Ill. P. C. Spencer, president of the parent company, has been elected president of Sinclair Research Laboratories, Inc. Other officers will be E. W. Isom, chairman of the board; W. M. Flowers, executive vice president, and E. C. Herthel, vice-president.

Institute Spokesman, Vol. 14, No. 11, February, 1951

EVALUATION AND USE OF SYNTHETIC GREASES

Glass, E. M., Rubin, B. and Wilcock, D. F.—pp. 7, 9-11, 13-15, 17-19

Synthetic greases for current Army Specification AN-G-25 generally consist of di-(2 ethyl hexyl) sebacate and a lithium soap. Comparison of grease properties of Specifications AN-G-25, AN-G-15 and AN-G-3a are shown. Wear rates of 13 greases and 6 oils in milligrams per 1000 cycles are given. A table compares an AN-G-25 grease with extreme pressure additive to Spec. AN-G-10 and MIL Spec. Superseding AN-G-10. It is believed that it is possible to manufacture — 100 F. grease using selected diesters. Silicone greases have been run 400-500 hours at 400 F. and 10,000 r.p.m. Another possibility for high temperature applications is a grease made of a soda soap and polyester oil. Greases based on silicone oil which would be far superior torque-wise, as well at high temperatures are lacking in the ability to lubricate gearing.

GREASE ADDITIVE

Anon.—p. 22
(Business Week, December 23, p. 31)

Butren is an additive for oils and grease, claimed to reduce friction by as much as 88%. It is made by Trans-World Oil Company of Seattle. Composition is not given.

Lubrication Engineering, Vol. 7, No. 1, February, 1951

LUBRICATING GREASE; FUNDAMENTALS OF LUBRICATION NUMBER 2

Miller, G. W.—pp. 10-14

The types of grease generally used include the following: 1. Water-resistant type for applications from below zero to approximately 180 F. operating temperatures. This classification takes into consideration generally, calcium and aluminum base greases. 2. Water-soluble type for applications from average operating temperatures above freezing to temperatures ranging up to 300/400 F. and over-generally the soda base greases. 3. Multi-purpose greases—water-resistant types—covering both low and high temperature applications. 4. Greases using synthetic fluids in place of natural mineral oils. Additives, fillers, and the value of the common physical test procedures are briefly considered.

AN INVESTIGATION OF THE FLOW OF A CUTTING OIL IN MACHINING OPERATION

Lauterbach, W. E. and Ratzel, E. A.—pp. 15-19

For very low cutting speeds, the cutting oil penetrates between the tool and workpiece and between the tool and chip, entering from the clearance crevice (crevice formed by tool and workpiece) anl not from the rake crevice (crevice formed by tool and chip). At cutting speeds above 10 feet per minute, penetration of the cutting oil could not be detected.

THE SEPARATION OF LUBRICATING, HYDRAULIC ACTUATING AND COOLING SYSTEMS IN MACHINE TOOL DESIGN

Morrell, D. P. and Hoover, O. E.—pp. 20-21, 35

Combined hydraulic and lubrication systems result in excessive contamination and oxidation of the hydraulic fluid, and quite often the oil used does not have the correct properties for both hydraulic and lubrication types of service. Combined hydraulic oil and tool coolants result in excessive sludging and sticky controls. (Presented at 5th Annual Convention of American Society of Lubrication Engineers, Detroit, Aprill 11, 1950.)

Lubrication (Texas Company), Vol. 37, No. 2, February, 1951

LUBRICATION IN THE SOAP INDUSTRY

Anon.—pp. 13-20

The stages in soap making are reviewed. The primary requirement in lubricating machinery in the soap plant is cleanliness. Generalized statements on selecting lubricants are given.

Oil and Gas Journal, Vol. 49, No. 41, February 15, 1951

HOW GREASE LUBRICATES—1

Anon.—p. 121

The electrical field of a metal surface attracts electrically active soap molecules. These polar molecules attract and hold in place oil molecules which are similar, thus forming a lubricating film. That part of the grease beyond the metal's electrical field is made up of a three-dimensional, lattice-like structure of soap fibers, which entraps and holds the oil within this structure.

No. 43, March 1, 1951

HOW GREASE LUBRICATES—3

Anon.—p. 87

When a bearing is put into operation the principle of the lubricating wedge comes into play. The grease in an operating bearing can be visualized as being split into multiple layers which slide over each other in the direction of journal rotation. The number of layers into which the grease is sheared probably depends on a combination of many factors such as the speed of the journal, the viscosity of the oil used, the kind and amount of soap used, manufacturing methods, operating temperature, etc.

No. 45, March 15, 1951

FACTORS IN GREASE CHARACTERISTICS

Anon.—p. 105

Type of soap was of chief importance in determining grease characteristics in the early days. Latest findings show factors that are most important: 1. The kind of metal atom in the soap or soaps. 2. The fats or fatty acids from which the soap is made. 3. The percentage of soap used. 4. The characteristics of the petroleum oil used. 5. Water, glycerin, and other materials. 6. Chemical "additives." 7. Techniques used in manufacturing.

No. 46, March 22, 1951

EFFECT OF PRESSURE ON VISCOSITY

Nelson, W. L.—p. 123

The effect of pressure is small at ordinary operating pressures, but at 1,000 psi. the effect becomes important and at 50,000 psi. as encountered in bearings some oils begin to solidify.

THE REFINER'S HANDBOOK No. 64 SPECIALIZED GREASES

Anon.—p. 127

Some of the chief grease characteristics that are obtained with soaps of various types are discussed in this installment of the Refiner's notebook.

Petroleum Engineer, Vol. 23, No. 2, February, 1951

LUBRICATION OF REFINERY EQUIPMENT. PART 2 (CONCLUSION)

Larson, C. M.—pp. C-19—C-20, C-22—C-24, C-26

Lubrication requirements for steam pumps, air compressors, roller chain drives, and gears, are given. A general lubrication chart is presented, covering the mechanical equipment found in a typical oil refinery. Each separate unit is listed for the particular lubricant recommended, together with its application.

Petroleum Engineer—Combined Edition, Vol. 23, No. 3, March, 1951

DIESEL ENGINE LUBRICATING OILS

Rawlins, E. B.—pp. D-31—D-36

This review considers problems of diesel engine lubrication, their causes, and some suggested aids to their elimination.

BIBLIOGRAPHY—CLASSIFIED LIST OF IMPORTANT PAPERS FOR 1949-1950

Anon.—pp. E-15, E-17, E-19, E-21

Important papers on petroleum engineering presented at various association meetings are listed by society and by subject.

Petroleum Processing, Vol. 6, No. 3, March, 1951

IMPROVED TESTING, RESEARCH METHODS FEATURED IN PURE OIL'S NEW LABS

Anon.—pp. 268-271

New features in oil company research and product testing facilities are incorporated in Pure Oil Co.'s new research center at Crystal Lake, Ill., which was formally put into operation a few months ago. The improvements include: headroom to spare in the pilot plant area—45 ft.; special photographic department to "record" test results; new rapid test methods for analyzing used oils; and special mountings to eliminate engine vibration.

COMPRESSOR LUBRICANTS — AND HOW TO SELECT THE RIGHT ONES

Hollister, K. L.—pp. 272-274

The lubrication requirements of different type compressors in a wide range of services were studied. Different oils, including the new types, were tested for their characteristics of importance in compressor lubrication. The resulting data provided a basis for the selection of commercial compressor lubricants. Factors to consider in the choice of lubricants where petroleum and other gases are compressed are discussed briefly, also the lubrication needs of special types of compressors.

Petroleum Times, Vol. 50, No. 1397, February 23, 1951

"HYDRAULIC SYSTEMS AND OILS"

Anon.—p. 124

The new series of books being issued by Shell Petroleum Company are virtually text books of great practical value on refined oils of particular properties for specialized spheres of engineering equipment. The two already issued are "Cutting Oils" and "Insulating Oils for Transformers and Switchgear." Now to these is added "Hydraulic Systems and Oils." The 116 pages of this work cover all present-day oil-hydraulic equipment in the following six chapters: 1. hydraulic systems—pumps; 2. hydraulic systems—driven units and their control; 3. hydraulic systems — applications; 4. hydrokinetic transmissions; 5. hydraulic seals; and 6. hydraulic oils. An appendix gives five pressure/viscosity curves covering hydraulic oils Nos. 1 to 5, temperature/viscosity curves for the same oils, relative density/pressure curves for water and typical hydraulic oils, and also a viscosity conversion table. Copies are available in the U. K. from Shell-Mex and B. P. Limited.

Vol. 55, No. 1395, January 26, 1951

"ROCK DRILL LUBRICATION"

Anon.—p. 66

A non-technical booklet by C. C. Wakefield and Company, "Rock Drill Lubrication", has sections on: (i) rock drills; (ii) factors affecting the operation of pneumatic tools; (iii) the lubrication of rock drills and kindred pneumatic tools; (iv) air line lubricators; and (v) care and maintenance.

No. 1398, March 9, 1951

PROGRESS IN THE SCIENCE AND ART OF LUBRICATION

Paterson, E. V.—pp. 169-171

This quarterly review considers the new revised S.A.E. classification, additives and filters, series 2 oils, low viscosity oils, nylon and self-lubricating bearings, extreme pressure lubricants, leaded greases, and the American Society of Lubrication Engineers service organization.

Plant, Vol. 3, No. 2, February, 1951

LUBE OIL ADDITIVES THEIR FUNCTIONS AND APPLICATIONS

Pritchard, C. E.—pp. 33-35, 62

Additives discussed in this article include antioxidants, catalyst deactivators, and anticorrosive agents. Oxidation inhibitors may be antioxidants, metal deactivators, or metal passivators.

Revue de l'Institut Francais du Petrole et Annales des Combustibles Liquides, Vol. 6, No. 1, January, 1951

A. G. M. A. STANDARD SPECIFICATIONS. LUBRICATIONS OF ENCLOSED AND OPEN GEARING.

Anon.—pp. D 20-D 22
(A. G. M. A., 250, 01, June, 1946, tabl.)

ADDITIVES CAN IMPROVE EFFICIENCY AND REDUCE MAINTENANCE.

Emerson, B. P.—pp. D 22-D 23
(Motorship, April, 1950, pp. 32, 37)

The author takes up additives for diesel oils and additives for lubricants showing how efficiency is improved and maintenance made easier. He particularly takes up an additive called "Lubal" which has been used for diesel operations for about 25 years. The composition of "Lubal" (its various trade designations, etc., such as Lubal D and Lubal K) is not indicated in the abstract given in this French journal.

FLOW OF LUBRICATING OIL FROM A BIG-END BEARING

Withers, J. G. and Wachal, A. L.—pp. D 24-D 25
(Engineering, Vol. 169, pp. 4388. 247-9, Mar. 3, 1950; and Vol. 169, pp. 4390, 291-2, Mar. 17, 1950)

CUTTING OIL RECLAMATION PAYS OFF

Baur, S.—p. D 25
(Iron Age, Vol. 166, No. 9, pp. 90-93, Mar. 2, 1950)

The author discusses the recovery of cutting oil.

IMPORTANCE OF CONDITIONED SURFACES IN LUBRICATION

Anon.—p. D 28
(Oil Engine Gas Turbine, Vol. 18, No. 205, p. 37, May, 1950)

The author discusses conditioned surfaces in lubrication and takes up the work of Trillat and discusses work done at the University of London and also in the United States by the National Advisory Committee for Aeronautics.

SAE Journal, Vol. 59, No. 2, February, 1951

TELLS STEPS IN LUBE OIL REFINING

Anon.—p. 103

How high-quality lubricating oils are refined was discussed by M. S. Obenauf head of lubricating sales promotion for Standard Oil Co. of Ohio. Obenauf explained in detail the solvent refining method now employed at the newly-erected plant near Lima, Ohio. At this plant Illinois crude is used almost exclusively. Only 40% of the crude is further refined after the crude distillation. Of this 40%, 24% is gas oil, 13% asphalt, 20% is extract, 9% wax, 1% color bodies, and 33% high quality lubricating oils.

Scientific Lubrication, Vol. 2, No. 12, December, 1950

LUBRICATION PROBLEMS OVERSEAS

Tongue, Robert W.—pp. 23-25

In those countries where backward natives form a large proportion of the labor force, the lubrication problems encountered are somewhat different from those of more civilized areas. The writer speaks from experience in India, and South-West Africa, and the chief difficulty is the child-like lack of responsibility met with in the native workers.

(*Continued on page* 139)

Book Reviews

The Practice of Lubrication

By T. C. Thomsen
McGraw-Hill Book Company, Inc., New York, 1951, 617 pages. Fourth Edition, Price $8.00.

The Fourth Edition of this text is a thorough and complete revision. As in previous editions, a comprehensive coverage of the origin, nature, testing, selection and use of all types of lubricants is considered. The book presents a number of typical lubrication problems and carefully analyzes each of them from several viewpoints to show how a successful lubrication solution can be evolved. Inherent characteristics of lubricants and evaluating procedures are given in such detail that the material is of use, not only to users, but to lubricant manufacturers and chemical technicians as well. The effect of high pressures, and extremes of heat and cold are indicated in regard to standard lubricants and to those of synthetic origin as well as those supplied with inhibitors.

In chapter arrangement, consideration is given to the problems of lubrication referred to various types of equipment such as textile machinery, transmission shafting, steam turbines, steam engines, air compressors, refrigerating machinery, internal combustion engines, and miscellaneous applications. The presentation is not mathematical and is very readable.

B. H. JENNINGS

Metal Working Lubricants

By E. L. H. Bastian
McGraw-Hill Book Company, Inc., New York, 1951, 357 pages. Price $6.00.

This book presents a comprehensive and practical coverage of all types of fluids and compounds used to facilitate metalworking processes. The nature, selection and application of lubricants and fluids are thoroughly discussed.

Illustrations of actual shop operations which demonstrate the various lubricant applications, tabulated data on the properties of lubricants and fluids, and charts containing recommendations for specific applications all make this volume an easy-to-use reference work. They also provide solutions to numerous questions which arise when it comes to selecting and using the right lubricant in the right way for a given operation.

New lubricants such as molybdenum disulphide, chemically active waxes, water-miscible oils for drawing fine-gauge wire, spinning lubricants used for TV tube production, and a variety of synthetic fluids and compounds are all covered in detail.

Though it deals primarily with practical shop and plant aspects, this book also includes adequate technical and theoretical explanations of the problems involved in the use of metalworking fluids and lubricants.

PERSONALS

Bath Joins Battenfeld: Mr. A. J. Daniel, President of the Battenfeld Grease & Oil Corp., has announced the appointment of T. Nicholas Bath as Chief Lubrication Engineer for Battenfeld.

Mr. Bath has had a long and distinguished career in the petroleum industry. He graduated from the University of Illinois in 1929 with a Degree in Chemical Engineering. He served as a chemist for the Pennsylvania Petroleum Co. and the Kansas City Testing Laboratories before joining the Shell Oil Co. in 1935. Upon leaving Shell in 1950 his capacity was that of Assistant Manager of the Lubrication Department in charge of nation-wide industrial lubrication sales.

Schmitt to Philadelphia: The appointment of Charles R. Schmitt as Manager, Lubrication Sales Department, has been announced by E. F. Houghton & Co., of Philadelphia, manufactures of industrial lubricants, metal and textile processing products and leathers.

Mr. Schmitt, formerly Lubrication Manager for the Central and Western Division, has been transferred to the company's main office in Philadelphia from Cleveland. He holds a degree in Mechanical Engineering from the Case School of Applied Sciences, joining Houghton in 1942.

Mr. Schmitt has been very active in the Cleveland Section serving in several official capacities. His work with the group has been outstanding and we know Philadelphia will welcome him to their Section.

CURRENT LITERATURE

(*Continued from page* 138)

FIRST PRINCIPLES; No. 17. OIL OR GREASE?

Anon.—p. 28

Generally speaking, oil is the best lubricant if it can be employed. Since the main object of lubrication is to reduce friction, oil is preferable because it provides less frictional resistance than grease, but there are many cases where oil cannot be employed, and there are also a number of instances where grease is best.

LUBRICATION IN TEXTILE MILLS

Anon.—pp. 20-22

A talk given by F. N. McLaren, Industrial Sales Dept., Anglo American Oil Co. Ltd., to the Oldham Cotton Mill Managers' Association recently stated that at the Exhibition of Textile Machinery at Atlantic City, this year. many manufacturers laid stress on the savings in manpower to be derived from simplified lubrication procedures.

Vol. 3, No. 3, March, 1951

THE APPLICATION OF RADIOACTIVE TRACERS TO THE LUBRICATION INDUSTRY

Leicester, G. M.—pp. 11-14

Using radioactive piston rings, engine tests may be made and the lubricant checked periodically for radio-activity. In this way, extremely small amounts of metal, of the order of a thousandths of a microgram, may be detected and the tests run without stopping the engine, so that a series of tests using different lubricants can be carried out under identical conditions. An investigation was carried out by Clarke, Gallo, and Lincoln of Illinois University to determine the inhibiting effect of sulphur-containing additives on oil oxidation. A sulphurized olefin was prepared, tagged with radioactive S35 as tracer, and tests made on several types of commercial bearings both at room temperature and at 88 C. Film formation was easy to detect because of the presence of radioactive sulphur and was found to occur in all cases.

THE IMPORTANCE OF USING LOW VISCOSITY OILS

Thomsea, T. C.—pp. 16, 33

The importance of using low viscosity lubricants (with proper additives if necessary) for fluid, boundary, textile equipment, automobile engine, and transmission lubrication is stressed.

PROPERTIES OF LUBRICATING OILS AND ENGINE DEPOSITS

Anon.—p. 20

E. A. Bouman's book considers, classification, manufacture, testing oils, engine consumption, load, volatility of oils among other things. The review says much of the material is not up to date however.

EMBEDABILITY OF BEARINGS WITH ABRASIVE-CONTAINING LUBRICANT

Anon.—pp. 21-23

The minimum size of particle which can be stopped by the best automotive

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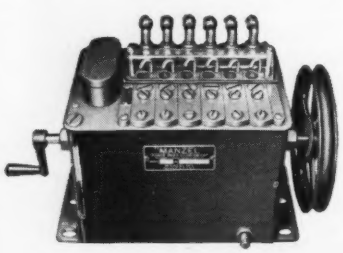

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cartridge-type filter is approx. 25 microns (0.001 in.). This size is larger than the minimum thickness of the oil film in many engine bearings. The bearing designer must therefore provide embedability, and maximum particle size may be taken as the criterion for maximum overlay thickness. The article is a shortened version of a paper recently given before the American Society of Mechanical Engineers.

LUBRICATING EQUIPMENT ON SHOW AT FUEL EFFICIENCY EXHIBITION

Anon.—p. 27

The theme of the lubrication display was "Profit from Correct Lubrication". The third annual Fuel Efficiency Exhibition was staged at the works of Messrs. Samuel Fox & Co. Ltd., Stocksbridge, Sheffield. A portion of the exhibition was devoted to lubrication.

FIRST PRINCIPLES: No. 19 MEASURING CONSISTENCY OF GREASES

Anon.—pp. 30-31

The Baird and Tatlock Penetrometer for use in determining worked and unworked penetration in greases (consistency) is described.

Science News Letter, Vol. 58, No. 25, December 16, 1950

SYNTHETICS SATISFACTORY

Anon.—p. 396

Synthetic lubricants, instead of petroleum products, have been found satisfactory in certain industrial applications, and their use is recommended because of superior qualities and the savings of petroleum for other purposes. Substantial savings in production costs and improved operation of mechanical equipment are possible. The American Society of Mechanical Engineers was told this by C. H. Sweatt and T. W. Langer, Union Carbide and Carbon Corporation. In addition to use as lubricants in the ceramic, dairy, metal working and rubber industries, they are finding applications as antifoaming agents, in nylon, glass, wool and rayon fibers, and as a substitute for oil in printing inks. The polyalkylene glycols and their derivatives constitute one class of synthetics differing considerably from petroleum products in physical and chemical properties. Properties of these lubricants include excellent anti-wear action, good load-carrying capacity, favorable viscosity-temperature relationships, low stable pour points, little or no solvent and swelling effect on either natural or synthetic rubber, and stability at elevated temperatures.

Super Service Station, Vol. 44, No. 2, February, 1951

SPRING SOLUTION

Anon.—p. 99

Newly-developed lubricant, Molybdenum Disulfide (Mo S2), dubbed "Moly Disul," announced by Tuthill Spring Co., Chicago, is said to reduce inter-leaf friction and squeaking of springs. Solution, it is claimed will "stay-put" without change in hot or cold weather, won't rub off at points of high-pressure contact, nor wash out with water or brine.

LUBE AID

Anon.—p. 103

No. 350 Linkage Adapter Assembly is being marketed by Universal Lubricating Systems, Inc., Oakmont, Pa. According to manufacturer it consists of 2 metal tubes joined by 360° all-steel swivel and fitted with coupler on either end. By means of this device, it is stated, it is possible to service fittings on many late model cars that cannot be reached with conventional equipment.

FOR GREASE REMOVAL

Anon.—p. 104

Graymills Corp., Evanston, Illinois, has developed new electrical Spray-Pump for removing grease and grime from engines and machinery that cannot be soaked in tank. Features of unit, as pointed out, are: does job without bother of hand pumping and without fog and fumes that result from use of air guns.

NEWS OF THE SECTIONS

(*Continued from page* 129)

one type in order to minimize misapplication.

"The Design, Application and Maintenance of Tapered Roller Bearings," by S. M. Weckstein, Ch. Engr., Ind. Div., The Timken Roller Bearing Co.—April meeting.

Ed. Note—See digest of Mr. Weckstein's talk in this issue which was also delivered before the Baltimore Section.

CHICAGO

"Multi-Functional Lubricants," by E. M. Kipp, Chief Lubricants Div., Aluminum Co. of America.—March meeting.

Dr. Kipp is Past President of ASLE and still very active in the work of the Society serving as Chairman of several of its Committees. He is an outstanding authority on his subject and presents his arguments in a most interesting and informative manner.

"Stump The Experts"—April meeting.

J. E. Rosnell of the Texas Co. served as Moderator at this always stimulating affair.

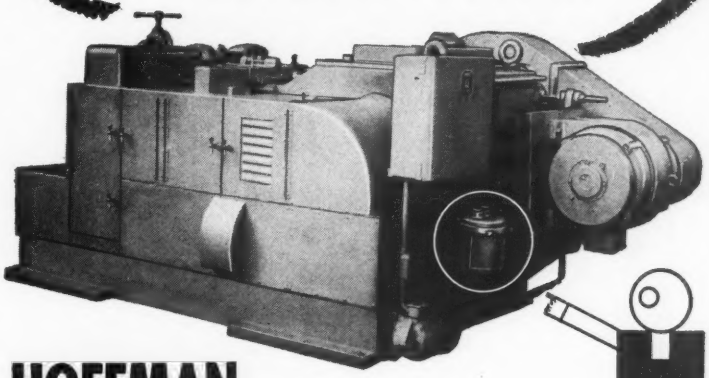
"Hydraulic Components and the Importance of using High Grade Hydraulic Fluids," by J. J. Scherer, Vickers, Inc.—May meeting.

Mr. Scherer has spent nearly seven years with Vickers and is competent to discuss his subject.

Ed. Note—An abstract of this presentation will appear in these columns in the August issue.

(*Continued on page* 143)

FOR BETTER OIL CLARITY —MORE ECONOMY



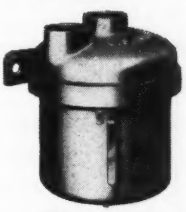
HOFFMAN DISC FILTERS NOW STANDARD on this Waterbury Farrel Hipro-Header

Despite a 10 to 1 difference in first cost, over previous filters, Hoffman Model I-6-15D Disc Filters proved more economical for Waterbury Farrel Foundry, builder of this high-speed Hipro Header.

Built to head bolts, screws, rivets, etc. from stock up to ⅜" O.D., this machine has a capacity of 115 units per minute. Extensive tests revealed that operation with the Hoffman filter meant greater lube oil clarity and longer filter disc life – thus, greater operating economy for the purchaser.

Hoffman disc filters have cleanable discs. Filtration at operating pressures up to 150 psi is accomplished without moving parts. Low maintenance cost. Write for Bulletin A669 for complete details *now*.

Hoffman Disc Filters, furnished in three sizes, may be installed singly or in units, to provide continuous clarification. Compact design for installation where space is limited. The I-4-15D delivers 1 to 10 g.p.m.; the I-6-15D provides 5-50 g.p.m. and the I-6-90D, 50 to 125 g.p.m. For the correct filter size for your requirement, Hoffman filtration engineers are at your service.



The I-6-15D

The I-4-15D

The I-6-90D

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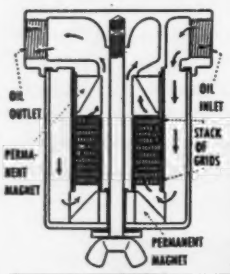

Cross-section of PQ-3 FerroFilter and smaller (above)

"Heart" of the FerroFilter (magnified inset shows collected magnified particles on screen edges) (below)

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COMMENTS

(*Continued from page* 125)

characterized a 40 hp and 7½ hp hydraulic drive, which had been in operation 16 years, with the phrase, "We just don't know the drives are there." The original investment for six pumps and motors was $4431.00. Investment in spare parts, consisting essentially of pipe flange gaskets, was $20.25 or an average of $1.27 per year. These drives operate continuously 16 hours per day and are started and stopped frequently to receive stock and operate in a hot, humid basement where steam, water and processing liquids are present. On this and manifold similar installations, spare units and spare parts of any sizable amount would be a poor investment—especially when spare or replacement units are usually available from the supplier.

Aim No. 7, "SELECT GOOD MEN FOR YOUR HYDRAULIC MAINTENANCE AND TRAIN THEM AS SPECIALISTS," bears repeating. We believe that all established hydraulic equipment manufacturers have, for many years, opened their plant doors to users for the purpose of training men in the art of hydraulic maintenance. We consider this a valid and profitable investment of mutual value. Then, too, qualified engineers representing manufacturers have prepared and conducted courses on hydraulic maintenance at schools, colleges and users' plants. Fenn College, Cleveland, Ohio, is one of the colleges presenting an evening course on hydraulics.

In concluding, it should be emphasized that hydraulic maintenance can only be reduced by the proper selection of components for each specific application. No amount of maintenance will rectify improper units installed on the machine. Establish a check list for the design of hydraulic circuits which assures you that the desired operation will be obtained under all varying circumstances, that proper safety and emergency devices are incorporated, that the ultimate in performance is assured, that maintenance is easily attended to, that the cost of the hydraulic system includes the complete installation and that the final appearance produces a balanced harmonious machine. Strive for durability and simplicity; keep components, piping and fittings to a minimum and low maintenance and good housekeeping will bring you profitable returns.

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Assistant Chief Engineer for its Oil Filter Division is required by a nationally known Midwestern automotive parts and equipment manufacturer.

Prefer graduate mechanical or chemical engineer with at least 2 years filtration experience who is ready for a major assignment.

Include full personal data, salary desired and availability in first letter. All replies held confidential.

Box 137

LUBRICATION ENGINEERING

343 S. Dearborn St. Chicago 4, Ill.

(*Continued from page* 141)

Section officers for the 1951-52 season were elected at this meeting.

BUFFALO

"In The Mill," by C. C. Goehring, Field Engineer for Heavy Industries, Esso Standard Oil Co. — March meeting.

The paper covered the problem of lubrication in rolling mills.

"The Research Development of a Lubricant, as Illustrated by a Soluble Oil," by T. C. Langer, Linde Air Products Div. of Union Carbide and Carbon Corp.—May meeting.

The role of the research and development staff in producing better lubricants was discussed. Among the items stressed were:

1. Recognition of the need for a new or improved product.
2. What each ingredient does.
3. What laboratory tests do or do not show.
4. How the final formula is selected.

PHILADELPHIA

By William Eismann, Jr., Secretary

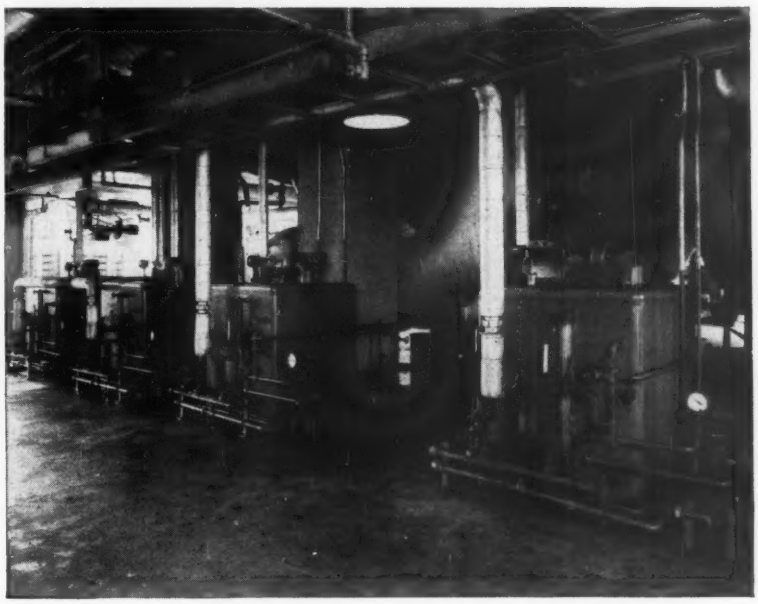
"Lubrication in Industry," by D. F. Hollingsworth, E. I. Du Pont de Nemours & Co., Inc.—March meeting.

The subject was treated principally from the angle of the economic advantages which can be derived from a well-planned and thoroughly applied lubrication program. For such a program to take effect the lubrication engineer and purchasing department can work together to consolidate the purchasing of lubricants with a resultant decrease in inventory.

A study of improved application methods requires the establishment of routines for the lubrication of each machine. This reduces haphazard lubrication with a consequent decrease in downtime and attendant reduction in maintenance cost. After application schedules have been adopted a further saving can often be made by looking for and suggesting better means of application of the lubricant.

(*Continued on page* 145)

Lubrication Insurance for TURBINE BEARINGS



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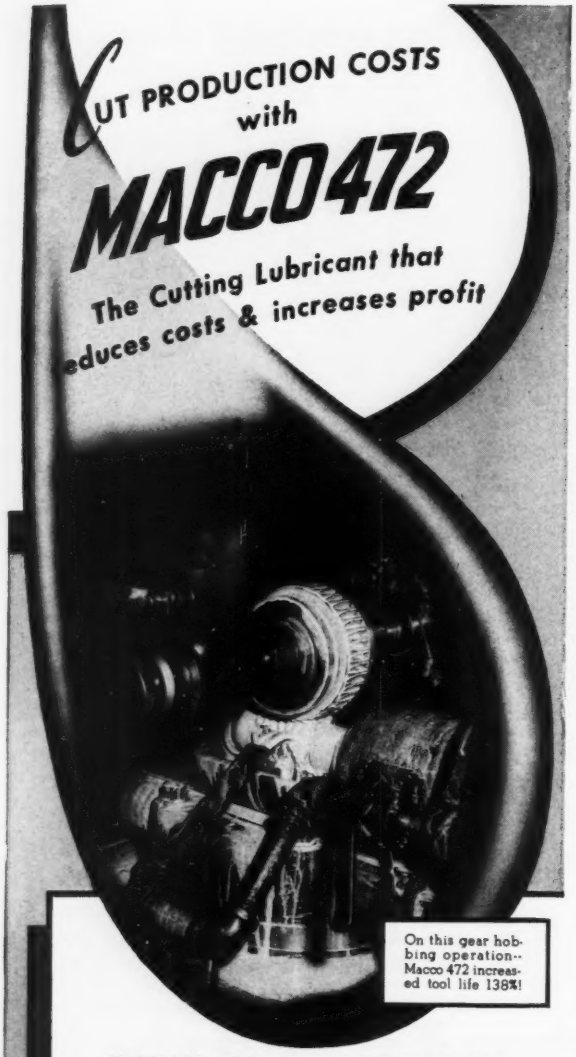

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THE MECHANISM OF GRINDING

(*Continued from page* 124)

ferred from the surface better with a liquid on it than with air alone. This heat transfer is, however, so slight compared with the flow of heat downward into the metal itself, that the actual rate of reduction of the surface temperature is only improved by about 5%. This indicates that the cooling effect of a lubricant on the surface is negligible. The lubricant does, however, prevent the bulk of the metal from getting overheated and distorted, and it is in this effect, together with that of reducing the total heat input, that the lubricant is of prime importance.

From these observations, it appears that the mechanism of ordinary grinding is:

1. A grain of the grindstone contacts the surface of the metal, raises its local temperature to near its melting point, and displaces it in the form of a furrow.
2. This furrow oxidizes and cools in an erect position.
3. This furrow is struck by following grains and broken off by a scouring action against the surface.
4. This broken off piece will be ejected by the wheel and the friction in this process will be reduced by a good boundary lubricant.

In this process the atmosphere is an essential element in the successful grinding of metal.

Acknowledgements

The author is greatly indebted to Dr. Milton C. Shaw for his invaluable help and advice. He also wishes to acknowledge the help of the Timken Roller Bearing Company without whose support this research could not have been undertaken, and to Mr. R. Earle Marshall for the use of his ingenious force measuring device.

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(*Continued from page* 143)

EVANSVILLE

By R. C. Garretson, Chairman

"The Action of Cutting Fluids in Machining," by Dr. M. Eugene Merchant, Senior Research Physicist, Cincinnati Milling Machine Co. —March meeting.

Since articles written by Dr. Merchant on this subject have appeared in LUBRICATION ENGINEERING before, along with digests of his talks, we feel that no further comments on his technical presentation are necessary.

On March 21 the Evansville Section held the most successful meeting of its two-year history, with an attendance 100% larger than usual.

Prior to giving his prepared talk, Dr. Merchant spoke informally in his role as Mid-Western Regional Vice-President and Chairman of the General Technical Committee. In discussing the functions of the various technical committees he pointed out that they are organized as a service to industry, to develop recommended procedures and practices, to give opinions, and to carry on research projects.

In answering several questions on the value to the individual of becoming a member of ASLE, Dr. Merchant emphasized the fact that all lubrication problems are of an engineering nature and that the solutions to these problems require an engineering approach though not an engineering degree. Lubrication engineering is rapidly becoming recognized as a profession and the efforts of ASLE are being expanded in that direction. The individual by contact with fellow members enlarges his own knowledge in the lubrication field and benefits to the extent of doing a better job, thus increasing his value to his company and thereby his own earning capacity.

In conclusion, Dr. Merchant pointed out that it is important to each of us as individuals to work together in the effort to impress upon management the need for lubrication engineering in industry. He suggested that Sections could help in this by keeping top management informed on the National Society's plans and projects, such as the conventions, the educational courses, research projects, etc.

Ed. Note—We should like to comment favorably on the monthly bulletin which this Section issues. It is composed of a list of the officers, an introduction of the speaker, the program for the evening, pertinent local comments and, finally, a list of the donors for the door prizes, etc. We feel this type of local publicity will stimulate attendance and attract new members in any Section that adopts it.

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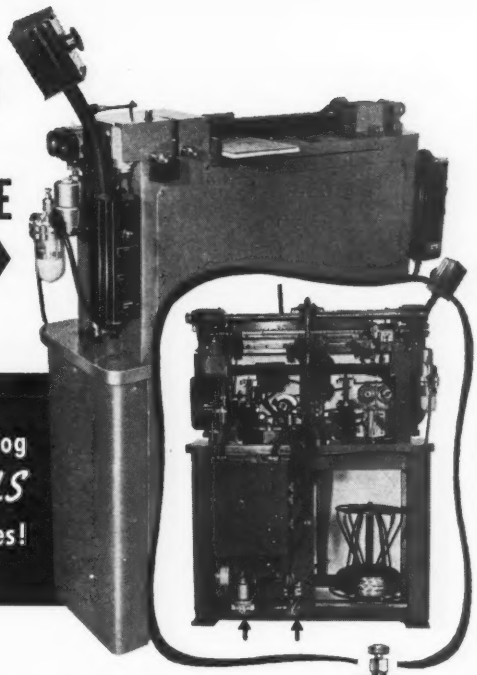

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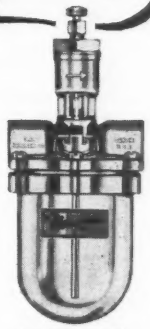

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PITTSBURGH

By M. C. Miller, Secretary

"Field Testing of Motor Oil and Gasoline," by A. C. Pilger, Tide Water Associated Oil Co.—March meeting.

Mr. Pilger discussed, among other factors, the effect of the length of the oil drain period on automotive engine performance. In his summarization he brought out the following salient points:

1. Gasoline is a source of engine varnish and sludge.
2. Oxidation stability and detergency characteristics of a motor oil influence engine deposits.
3. Viscosity of a motor oil affects the rate and amount of engine deposition.

(*Concluded on page* 151)

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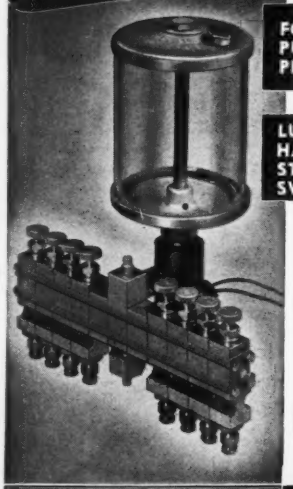

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OILS AND LUBRICANTS

PATENT ABSTRACTS

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 643, Nos. 1, 2, 3, 4; Vol. 644, Nos. 1, 2. 3. 4; Vol. 645, Nos. 1, 2, 3, 4.

Prepared by ANN BURCHICK

Hydrocarbon Additive Oils—Patent #2,540,114—Charles Hoffman, Thomas R. Schweitzer, and Mohammad Haider Anwar and Gaston Dalby, assignors to Ward Baking Co.

A hydrocarbon oil containing between 0.05% and 1.0% of the reaction product formed by heating above about 130 C. until oil soluble four parts by weight of sodium penta alkyl tripoly phosphate in which the alkyl radical has a chain of from 6 to 10 carbon atoms and at least five parts by weight of a member of the class consisting of the sodium sulphonates of saturated alkyl dibasic acid esters and of secondary alkyl sodium sulphates having a carbon chain of from 11 to 18 carbon atoms.

Treatment of Emulsions—Patent #2,540,437—Fritz E. Fuchs, assignor to Aquanox Corp.

A demulsifier composition for breaking water-in-oil petroleum emulsions consisting essentially of 15 to 3% of a polyoxyalkylene derivative of a hexitol anhydride partially esterified with a long chain fatty acid, and 85 to 97% of a mixture of water-soluble mahogany and green acid soaps and an oxidized fatty body, the proportions of said soaps to said oxidized fatty body in said mixture ranging from 10% of the one to 90% of the other, and the proportion of said mahogany acid soap to said green acid soap being about 10:7.

Demulsifier Composition—Patent #2,540,438—Fritz E. Fuchs, assignor to Aquanox Corp.

A demulsifier composition for the treatment of petroleum emulsions, comprising, a mixture of (A) petroleum sulfonate soap of the class consisting of mahogany and green acid soaps, (B) a castor oil modified alkyl resin, and (C) a compound consisting of a polyoxyalkylene derivative of a hexahydric body partially esterified with a long chain fatty acid, the weight proportions in said mixture of A ranging from about 30 to 75%; of B from about 15 to 60%; and of C from about 5 to 15%.

Sulfonate Grease — Patent #2,540,533 — John J. Kolfenbach and Rosemary O'Halloran; assignors to Standard Oil Development Co.

A lubricating grease composition comprising a mineral lubricating oil, 10% of an alkaline earth metal sulfonate, and 10% of a mixture of the lead and calcium salts of an acid selected from the group consisting of a low molecular weight aliphatic carboxylic acid having not more than 6 carbon atoms said mixture containing from 2.5 to 7.5% by weight of the calcium salt and from 7.5 to 2.5% by weight of the lead salt.

Extreme Pressure Grease—Patent #2,540,534—John J. Kolfenbach and Rosemary O'Halloran, assignors to Standard Oil Development Co.

An improved lubricating grease composition consisting essentially of a lubricating oil base stock having incorporated therein from about 5 to 20% of an alkaline earth metal sulfonate prepared from a sulfonic acid having a molecular weight within a range of from 300 to 600, from about 2% to 6% by weight of an alkaline earth metal sulfonate prepared from alkyl sulfonic acid having a molecular weight within a range of from 96 to 166 and about 2.5% to 7.5% of an alkaline earth metal salt of an aliphatic carboxylic acid having from 1 to 4 carbon atoms.

Quality of Olefin Polymer Lubricants—Patent #2,540,580—Raymond L. Heinrich, assignor, by mesne assignments to Standard Oil Development Co.

A method of producing an improved lubricating oil which includes the steps of contacting a mixture of an alpha olefin having a boiling point of less than 450 F. and a material selected from the group consisting of phosphorus and phosphorus pentasulfide with a Friedel-Crafts type catalyst in the presence of a diluent at a temperature in the range between 50 F. and 250 F. in the liquid phase for a time in the range between 1 and 3 hours sufficient for the simultaneous polymerization of the said olefin and for the reaction of the said olefin and its polymers with the said material to form a product suitable for use as a lubricating oil and recovering said product.

Emulsifiable Hydrocarbon Oils—Patent #2,540,795—John E. Schott and Ernst Laug, assignors to Socony-Vacuum Oil Co., Inc.

An emulsifiable oil composition, which comprises a major proportion of a hydrocarbon oil having in admixture therewith an oil-in-water emulsifier in an amount varying between about 8% and about 25% by weight of said composition, and a dibasic alkali-metal orthophosphate selected from the group consisting of disodium hydrogen orthophosphate and dipotassium hydrogen orthophosphate, in an amount varying between about 0.3% and about 4% by weight of said composition.

Lubricating Compositions—Patent #2,541,590—Robert G. Larsen and Kenneth E. Marple, assignors to Shell Development Co.

A lubricating composition comprising a major amount of a lubricant of the group consisting of mineral lubricating oil and dioctyl phthalate and a sufficient amount to increase appreciably the viscosity index of said lubricant of a copolymer of from 2 to 25% of a diester formed between phthalic acid and an unsaturated aliphatic alcohol having from 2 to 3 carbon atoms and from 97% to 75% of an ester of an allyl alcohol containing 3 to 18 carbon atoms with a saturated monocarboylic acid of from 8 to 13 carbon atoms, said copolymer having a degree of polymerization of 4.3 to 12.1, obtained by heating and polymerizing said mixture at 50 C. to 300 C. in the presence of a polymerizing catalyst of the group consisting of organic peroxides and metallic salts.

Mineral Oil Lubricant Containing Sulfurized and Phosphorized Propylene and Butylene Glycol Esters of Oleic Acid—Patent #2,541,789—Joseph B. Stucker, assignor to The Pure Oil Co.

A lubricant comprising a major portion of a Mid-Continent Solvent Refined petroleum lubricating oil and a minor portion of a composition as the principal additive, effective to improve its load carrying characteristics, which additive consists substantially of a sulfurized and phosphorized ester from the group consisting of propylene and butylene glycol dioleates, the sulfur content of said additive being about 1 to 10%, and the phosphorus content being about 0.2 to 0.6%, said additive being soluble in said oil.

Continuous Grease Manufacture—Patent #2,542,159—Langley B. Stevens, assignor to The Pure Oil Co.

The method of preparing sodium soap grease in a continuous operation comprising preparing a slurry of said soap in mineral oil, heating the slurry to a temperature between approximately 220 F. and 290 F. at which the soap is above its plasticity point but below its true melting point, homogenizing the slurry while at said temperature until it has attained the desired grease structure, and then reducing the temperature of the resulting grease below the plasticity point of the soap before packaging.

Mineral Oil Lubricant Containing Phosphorized and Sulfurized Glyceryl Trioleate—Patent #2,542,161—Joseph B. Stucker, assignor to The Pure Oil Co.

A lubricant additive substantially consisting of the reaction product of phosphorus sesquisulfide and sulfurized glyceryl oleates, at least 70% of said glyceryl oleates being glycerl trioleate, the sulfur content of said additive being about 1 to 10% and the phosphorus content thereof being about 0.2 to 6% by weight.

Lubricating Oil Containing Chlorinated Cyclic Polymer—Patent #2,542,286—Rupert C. Morris, John L. Van Winkle, and Alva V. Snider, assignors to Shell Development Co.

A lubricating composition comprising a major amount of a mineral lubricating oil and 0.1-20% by weight of a chlorinated cyclic polymer, said polymer having been prepared by heating methyl 1,3-pentadienes and sulfur dioxide at a temperature of 100-130 C. for 30-60 minutes, removing the sulfolene so formed to leave a mixture of methylpentadiene cyclic polymers predominantly having 4-10 methyl-pentadiene units and boiling above 250 C., and subsequently treating said polymer with chlorine at a temperature of 15-30 C. to form a chlorinated mixture of polymers having a chlorine content of 10-20% by weight of said polymer.

Lubricating Oil Additives—Patent #2,542,542—Samuel B. Lippincott and Louis A. Kikeska, assignors to Standard Oil Development Co.

A composition consisting essentially of a major proportion of an oil base stock and from 0.01 to 10% by weight of a product consisting essentially of a copolymer of maleic anhydride and octadecene, said copolymer being formed by condensing from 1 to 4 mols of said octadecene with 1 mol of the said anhydride in the presence of benzoyl peroxide catalyst at a temperature of from 100 C. to 200 C. at atmospheric pressure.

Unsaturated Tertiary Amine-P_2S_5 Reaction Products and Lubricating Oils Containing Same—Patent #2,542,981—John D. Bartleson and Everett C. Hughes, assignors to The Standard Oil Co.

A lubricant comprising a mineral lubricating oil and an amount within the range of 0.01% to 10% by weight to inhibit the deterioration of the oil in use of a derivative of a reaction product of an oil-soluble unsaturated tertiary amine and a phosphorus sulfide reacted in proportions within the range of 0.1 to 1.0 mol of the sulfide per olefinic double bond per mol of the amine and at a temperature within the range of 250 F. to 600 F. for a time of substantially complete the reaction to produce a deterioration inhibiting oil-dispersible reaction product, said derivative being selected from the group consisting of a metal derivative and a nitrogen base derivative thereof.

Unsaturated Amine-Sulfur Reaction Products as Lubricant Additives and Lubricating Oils Containing Same—Patent #2,542,982—John D. Bartleson and Everett C. Hughes, assignors to The Standard Oil Co.

A lubricant comprising a mineral lubricating oil and an amount within the range of 0.01% to 10% by weight to inhibit the deterioration of the oil in use of an oil dispersible reaction product of an olefinic unsaturated amine containing at least 12 carbon atoms and an aliphatic hydrocarbon radical having at least 10 carbon atoms and 0.1 to 1.0 atom of sulfur per olefinic double bond in said amine reacted at a temperature in the range of 200 F. to 300 F. for a time within the range of 1 to 3 hours to form an oil dispersible reaction product.

Stabilized Oxidizable Hydrocarbon Oil—Patent #2,543,074—William T. Stewart and James O. Clayton, assignors to California Research Corp.

An inhibited oxidizable hydrocarbon oil which is substantially free from groups including unsaturated groups, normally reactive with selenomercaptans and telluromercaptans, said oxidizable oil containing a small amount, sufficient to inhibit oxidation of said oil, of a compound of the structure

R—X—H

(*Continued on page* 151)

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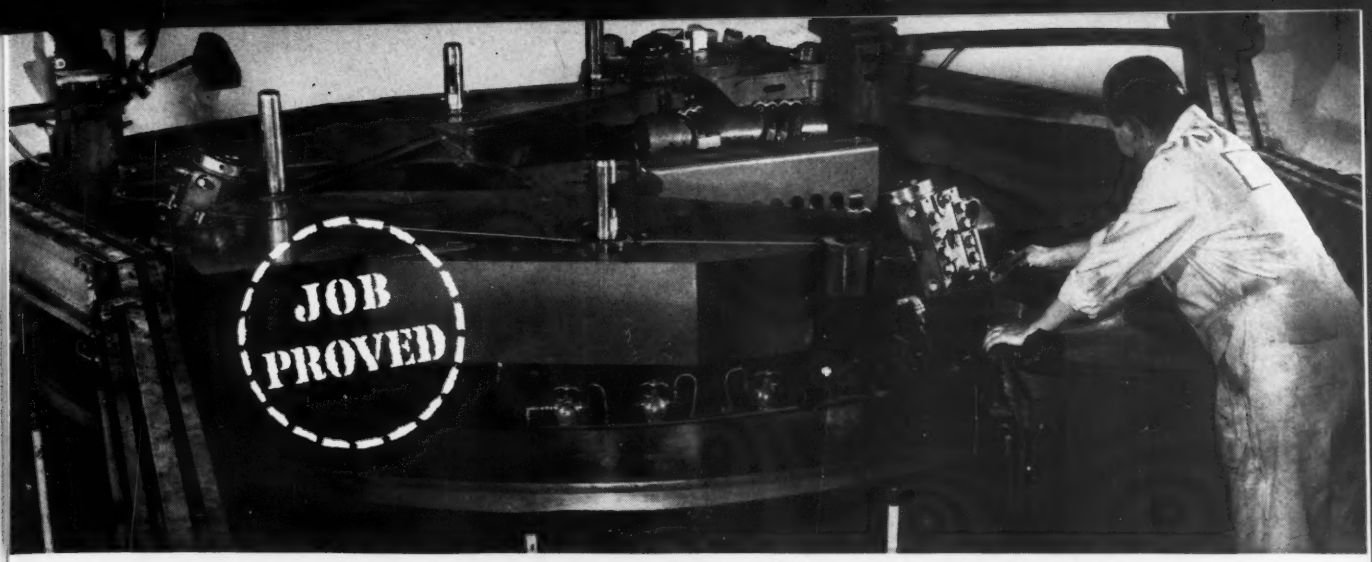

SCIENTIST at Cornell Aeronautical Laboratory gages thin oil film in wind tunnel's oil-cushioned balance system, which measures wind stresses on models to 1/100 of a pound. With the previous oil, rust particles formed, made accurate measurements nearly impossible. Frequent dismantling and cleaning were necessary at a cost of nearly $1,000 each time. Sunvis 931 Oil restored efficiency of the balance system and eliminated overhauls.

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Cornell Aeronautical Laboratory's transonic wind tunnel, valued at more than $3 million, determines the ability of planes to withstand winds up to 750 mph. Two years ago difficulties set in. In the delicate hydraulic balance system—where parts literally float on a film of oil—particles of rust were interfering with accurate measurements. Every few months the entire balance system had to be dismantled, thoroughly cleaned, then reassembled. But there is no problem today. It was solved when a Sun representative recommended Sunvis 931 Oil with "Job Proved" ability to prevent the formation of rust, corrosion, sludges, and gums.

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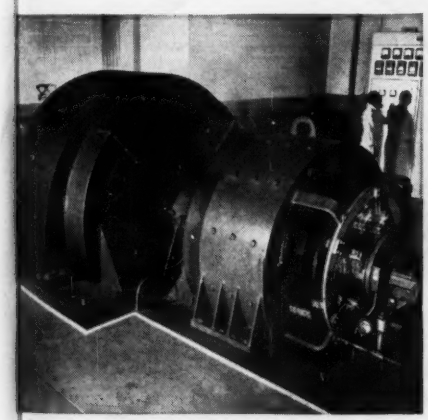
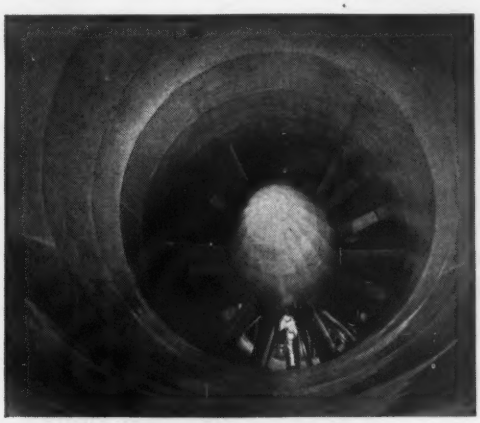
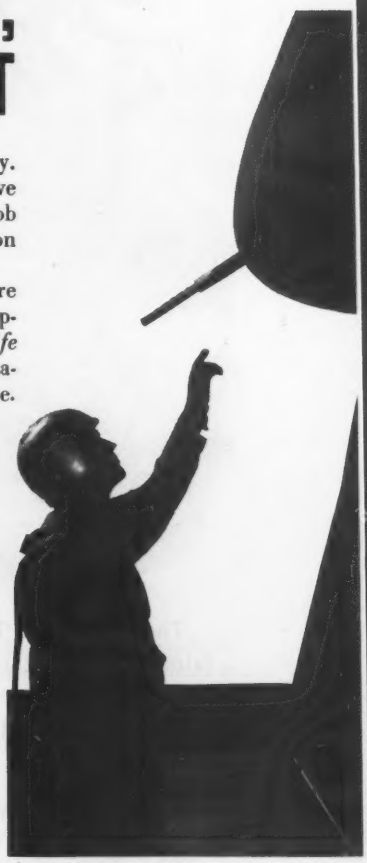


WINDS UP TO 750 MPH are generated by these two 12,000 hp electric motors directly connected to the main shaft. Sunvis 931 Oil lubricates and protects them, too.



TWO HIGH-SPEED propellers are also lubricated by Sunvis 931 Oil. It remains free-flowing, nonsludging, after more than two years' rigorous service.



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(*Continued from page* 145)

4. Motor oils vary markedly in their tendency to cause bearing corrosion.
5. Length of drain period, coolant temperature and crankcase ventilation, influence engine deposits.
6. Engine design differences cause marked changes in oil ring hole blocking, piston ring sticking and oil screen blocking.
7. Differences in operating conditions cause pronounced variations in the degree and type of engine deposits.

The local Section of ASLE participated in the ASME spring conference held in April at the William Penn Hotel. John Boyd demonstrated with models the design and lubrication of bearings. James Lewis discussed extreme pressure lubricants. It is pleasing to note the growing spirit of cooperation between these two fine outstanding organizations.

PATENT ABSTRACTS

(*Continued from page* 147)

wherein X is selected from the group consisting of selenium and tellurium, R is an aliphatic group of 5 to 30 carbon atoms and H is hydrogen.

Anticorrosive Lubricating Oil Composition—Patent #2,543,325—Raymond W. Mattson, assignor to Union Oil Co. of California.

A lubricating composition comprising mineral lubricating oil containing 0.1% to 3.0% by weight sufficient to impart anticorrosion properties to said oil of a compound of the class consisting of mercaptals, mercaptols and trithio ortno esters, said compound containing at least one substituent—OR group where R represents a radical of the class consisting of hydrogen and hydrocarbon radicals.

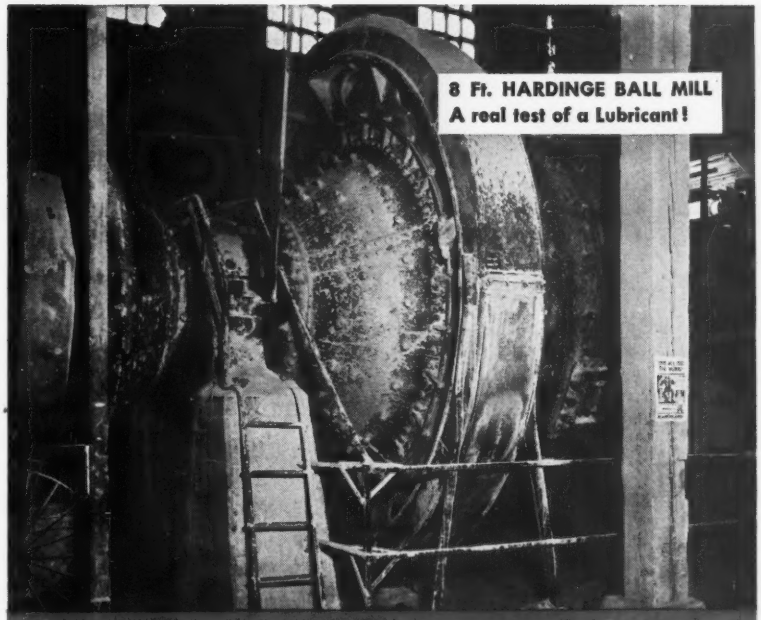
Mineral Oil Composition—Patent #2,543,542—Darwin E. Badertscher and Charles F. Feasley, assignors to Socony-Vacuum Oil Co., Inc.

An improved mineral oil composition comprising a viscous mineral oil fraction having in admixture therewith a minor proportion, sufficient to stabilize said oil fraction against the deleterious effects of oxidation, of an oil-soluble, sulfur-containing reaction product obtained by reacting one mol of a terpene with about two mols of a mercaptan, in the presence of a condensing agent, at a temperature of from about 0 C. to about 150 C. and for a time period of from about 1 to abou. 48 hours.

Mineral Lubricating Oil Containing a Combination of Metal Salts—Patent #2,543,734—William T. Stewart and James O. Clayton, assignors to California Research Corp.

A mineral lubricating oil comprising a major proportion of mineral oil and dissolved therein about 0.1 to about 2% by weight based on the finished oil of an oil soluble polyvalent metal salt of a compound selected from the group consisting of phenates and aromatic sulfonates, and about 0.1 to about 5% by weight of a polyvalent metal salt of an alkyl selenomercaptan containing 5 to 30 carbon atoms in the molecule.

(*Continued on page* 153)



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(*Continued from page* 151)

Lubricating Composition—Patent #2,543,735—William T. Stewart and James O. Clayton, assignors to California Research Corp.

A lubricant comprising a major proportion of an oxidizable polyether oil of lubricating viscosity, which oil is substantially free from groups normally reactive with selenomercaptans and telluromercaptans, said oxidizable oil containing a small amount, sufficient to inhibit oxidation of said oil of a compound of the structure

R—X—Y

wherein X is selected from the group consisting of selenium and tellurium, R is an aliphatic group of 5 to 30 carbon atoms, and Y is selected from the group consisting of hydrogen and the hydrogen equivalent of a cationic salt-forming group.

Lubricating and Sealing Composition of Flake Copper, Powdered Lead, Graphite, and Petroleum Vehicle—Patent #2,543,741—Henry C. Zweifel, assignor to Richfield Oil Corp.

A thread sealing and lubricating compound comprising essentially finely-divided copper in flake form of particle size within the range of from one micron to about 76 microns, powdered lead, amorphous graphite and a petroleum vehicle, the petroleum vehicle comprising from about 30% to about 85% of the compound and forming a medium in which the finely divided copper, the powdered lead and the amorphous graphite are suspended, the lead being present in amount from about one-third part to three parts by weight to each part by weight of the graphite, and the proportion of the finely divided copper to the combined amount of the copper, lead and graphite being in the range of from 5 to 100%.

Determination of Petroleum Sulfonate as a Demulsifying Agent for Water-In-Oil Emulsions—Patent #2,543,871—Richard A. Salathiel, assignor by mesne assignments, to Standard Oil Development Co.

A method for determining the suitability of a petroleum sulfonate as a demulsifying agent for water-in-oil emulsions which comprises dissolving the sulfonate in the form of its sodium salt and free from aromatic type solvents and inorganic salts in an oily non-aromatic type solvent to a selected concentration, adding the resulting solution in a regulated amount to a mixture containing selected quantities of a pure liquid hydrocarbon and a mutual solvent to produce a predetermined mixture containing the hydrocarbon, the mutual solvent and the sulfonate solution, adding to a desired portion of the mixture a selected volume of salt solution of a selected concentration, thoroughly commingling the various ingredients and then allowing the mixed ingredients to settle, repeating this series of operations each time using a salt solution of different concentration and observing the lowest salt concentrations which cause (1) a lower aqueous layer to separate from an upper phase containing said sulfonate and (2) said hydrocarbon and non-aromatic type solvent to become entirely miscible with a phase containing said sulfonate.

Water-Soluble Petroleum Sulfonates—Patent #2.543,885—Chester E. Wilson, assignor to Union Oil Co. of California.

A process for the production of water-soluble hydrocarbon sulfonates which comprises reacting a hydrocarbon oil fraction boiling substantially between 500 F. and 800 F. with a strong sulfonating agent at an elevated temperature to produce a crude sulfonation product, extracting said crude sulfonation product with a first solvent consisting essentially of at least one organic solvent selected from the class consisting of liquid aromatic hydrocarbons having 6 to 9 carbon atoms per molecule, monochlorinated liquid aromatic hydrocarbons having 6 to 9 carbon atoms per molecule and polychlorinated aliphatic hydrocarbons having 1 to 2 carbon atoms per molecule to form a first extract phase and a sludge phase, separating said first extract phase from said sludge phase, neutralizing the sulfonic acids in said first extract phase with an aqueous solution of a basically reacting alkali metal compound to form a first mixture, separating said first solvent from said first mixture leaving a second mixture, extracting said second mixture with a second solvent consisting essentially of at least one liquid aliphatic hydrocarbon having between about 3 and 10 carbon atoms to form a second extract phase and an aqueous phase, separating the second extract phase from the aqueous phase, and recovering said sulfonate salts from the aqueous phase.

Treating Hydrcarbon Oils—Patent #2,543,995—Theodore B. Tom, assignor to Standard Oil Co.

The method of stabilizing a copper-contaminated hydrocarbon oil comprising mixing said oil with an oil-immiscible solution of an organo-substituted acid of arsenic selected from the class consisting of an organo arsonic acid.

Lubricating Oil Containing a Polymer of Tetradecyl Vinyl Ether—Patent #2,544,375—John Mann Butler, assignor to Monsanto Chemical Co.

A lubricating composition which comprises a wax containing mineral lubricating oil having an ASTM pour point of from 15 F. to 50 F., containing intimately dissolved therein from 0.05 to 2% by weight of a polymer of tetradecyl vinyl ether.

Lubricating Oil Containing a Polymer of Oleyl Methacrylate — Patent #2,544,376 — John Mann Butler, assignor to Monsanto Chemical Co.

A lubricating composition which comprises a wax containing mineral lubricating oil of an ASTM pour point between —10 F. and +5 F., containing dissolved therein from 0.05 to 2% by weight of a polymer of oleyl methacrylate, said lubricating oil containing mineral oil as its major increment.

Addition Agents for Mineral Oil Lubricants — Patent #2,545,113 — Herschel G Smith, Troy L. Cantrell and John G. Peters, assignors to Gulf Oil Corp.

The process which comprises reacting an aqueous slurry of 1 mol of a metal hydroxide selected from the group consisting

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of barium, strontium, magnesium and calcium hydroxides with from 2 to 4 mols of formaldehyde at a temperature not exceeding 200 F. and condensing the resulting product at a temperature not exceeding about 200 F. with from 0.5 to 1 mol of aniline and from 2 to 4 mols of a monoalkyl phenol having from 4 to 12 carbon atoms in the alkyl substituent.

Lubricating Grease Composition—Patent #2,545,114—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp.

A grease composition comprising a mineral lubricating oil thickened to a grease by a soap, and a small amount of the reaction product prepared by reacting an aqueous slurry of 1 mol of a metal hydroxide selected from the group consisting of barium, strontium, magnesium and calcium hydroxides with from 2 to 4 mols of formaldehyde at a mildly elevated temperature and condensing the resulting product with from 0.5 to 1 mol of aniline and from 2 to 4 mols of a mono-alkyl phenol having from 4 to 12 carbon atoms in the alkyl substituent, said product being present in an amount sufficient to stabilize the grease against oxidative deterioration.

Alkali Base Lubricating Greases — Patent #2,545,190— Arnold A. Bondi, assignor to Shell Development Co.

A mechanically stable, thermally reversible, non-bleeding grease comprising a major amount of a lubricating oil, from 5% to 25% of an alkali metal soap and from 0.01% to 1% of a monohydrocarbyl ether of a polyalkylene glycol, said monohydrocarbyl group having from 6 to 32 carbon atoms and wherein said alkylene radicals of the polyalkylene glycol have from 2 to 6 carbon atoms each.

Microcrystalline Wax as an Antifoam Agent in Soluble Oil-Water Emulsion—Patent #2,545,677—Elmer H. Sperry, assignor to Sun Oil Co.

A composition of matter comprising a soluble oil having the known composition of a major proportion of a mineral oil and a minor proportion, effective to impart to the mineral oil miscibility with water of a soap, said known compositions being characterized by miscibility with water to form an emulsion having foaming properties and microcrystalline wax having a melting point of from 145 F. to 200 F. and a molecular weight of from 500 to 850 in a quantity comprising a small fractional proportion of said soap and effective to inhibit excessive foaming and to cause rapid defoaming.

Sulfurized Lubricant — Patent #2,545,875 — George N. Cade, assignor to Phillips Petroleum Co.

A method for preparing an additive for lubricating oils, which comprises reacting in a reaction zone a hydrofluoric acid-soluble oil with from 5 to 50 weight per cent of elemental sulfur based on said hydrofluoric acid-soluble oil, said hydrofluoric acid-soluble oil being obtained from an alkylation process wherein an alkylatable paraffin is alkylated with an olefin in the presence of hydrofluoric acid as a catalyst, maintaining a temperature in said reaction zone in the range between 180-400 F. for a period of time in the range of from 1 to 10 hours, and recovering a resulting sulfurized oil capable of imparting improved extreme pressure characteristics to lubricating oils when blended therewith.

Lubricants—Patent #2,546,552—Clarence M. Loane and Lawson W. Mixon, assignors to Standard Oil Co.

A non-aqueous lubricant composition comprising a major proportion of a hydrocarbon oil and in combination therewith from about 0.001% to about 10% of a potassium-containing neutralized reaction product of P_2S_5 and an olefin polymer having a molecular weight of from about 500 to about 10,000 obtained by reacting said olefin polymer with from about 1% to about 50% P_2S_5 at a temperature of from about 200 F. to about 500 F. and neutralizing the resultant reaction product with a potassium-containing basic reagent, and from about 0.01% to about 10% of a potassium salt of a propylene polymer alkylated benzene sulfonate, said propylene polymer having a molecular weight of from about 100 to about 5000.

Lubricating Oil—Patent #2,546,941—William Davey, assignor to Shell Development Co.

A lubricating composition consisting essentially of a major amount of a hydrocarbon oil and a minor amount of less than 1% sufficient to impart extreme pressure properties to said lubricant of trichloromethyl di(thiaethyl) methane.

Process and Reagents for Resolving Emulsions—Patent #2,547,188—Truman B. Wayne.

A composition for resolving a petroleum emulsion and dispersible in such an emulsion, which comprises as a component, a water wettable, interfacial and surface-active condensation product of a polybasic carboxy acid and a hydroxylated amino compound derived initially by a reaction selected from the group consisting of amidification, esterification and soap-formation between a detergent-forming acid and a hydroxy amine.

Process of Refining Mineral Oils—Patent #2,547,629—Bruno Kuno Engel and Fredrik Teodor Emanuel Palmqvist, assignors to Aktiebolaget Separator-Nobel.

The process of refining lubricating oils, which comprises continuously introducing, in a primary step, fresh concentrated sulfuric acid into a stream of oil to be refined, intimately mixing said oil with said sulfuric acid to extract the more unstable components of the oil, centrifugally separating said mixture into an acid-containing raffinate phase and an extract phase before any noticeable water-yielding chemical reaction between said acid and oil with subsequent re-dissolution of acid reaction products in the raffinate phase has taken place, allowing, in a secondary step, the free acid of the acid-containing raffinate phase to react with the more stable reactive components therein, to produce a separable acid sludge, and separating said acid sludge from the raffinate phase by centrifuging.

Polymerized Fatty Oils—Patent #2,547,760—James C. Konen and Edwin T. Clocker, assignors to Archer-Daniels-Midland Co.

The process of treating an unsaturated fatty oil which comprises blowing the unsaturated fatty oil to add oxygen to the molecules of the oil, forming a mixture

of the blown oil with boron fluoride as polymerization catalyst in the proportion of at least 0.01 part for 100 parts by weight of the oil, and maintaining the mixture at a temperature between room temperature and 250 F. until the viscosity of the oil is equivalent to the viscosity of an indiulated oil having a viscosity in excess of 100 poises, the oil so produced having a greater tolerance for mineral spirits than the unsaturated oil thickened by blowing alone to the same viscosity.

Fuel Oil Composition—Patent #2,548,347—John B. R. Caron, Everett G. Glendenning and Calmy Wies, assignors to Shell Devleopment Co.

A fuel oil containing substantial amount of cracked components and entrained moisture and normally susceptible to cause clogging said fuel oil rendered nonclogging by incorporation therein from about 0.0025 to about 0.005% of sorbitan monolaurate and about 0.0025% of barium salt of alkyl phenol disulfide.

Lubricating Means Resistant to Chemical Attack—Patent #2,548,471—John F. Gall, assignor to The Pennsylvania Salt Mfg. Co.

In processes for handling highly reactive materials involving contact of such materials with surfaces designed to be moved relatively to each other, the improvement that comprises maintaining, as lubricant between said surfaces, a liquid composition containing metal fluoride and hydrogen fluoride, said composition containing from 1 to 7 mols hydrogen fluoride per mol metal fluoride.

Rust Preventive Film—Patent #2,549,05?—John J. Brophy, Bernard M. Pineles and Robert C. Putnam, assignors to United Shoe Machinery Corp.

A liquid, freely flowing composition comprising from 4 to 6 parts by weight of a non-corrosive, non-drying hydrocarbon oil, 15 parts by weight of a water-insoluble, film-forming colloid from the group consisting of cellulose ethers, cellulose esters and copolymers of vinyl chloride and vinyl acetate containing at least 85% of vinyl chloride, and from 2.5 to 8 parts by weight of glyceryl monolaurate, all dissolved in a volatile organic solvent.

Desulfurization of Hydrocarbon Oils—Patent #2,549,052—Kenneth M. Brown and Warren W. Johnstone, assignors to Universal Oil Products Co.

A process for removing acidic organic compounds from hydrocarbon oil heavier than gasoline which comprises contacting said oil with an alkali-solvent solution containing from about 2 to about 20 volumes of heavy xylenols per 100 volumes of said solution, and separating treated oil from said solution.

Lubricant and Hydraulic Fluid Composition—Patent #2,549,270—Forrest J. Watson, assignor to Shell Development Co.

A composition of matter consisting essentially of 50-85% by weight of a trialkyl phosphate, each alkyl radical of which contains 4-8 carbon atoms, 10-40% by weight of tricresyl phosphates, and a minor amount sufficient to thicken said phosphates of up to 10% by weight of a linera polymer of methacrylic acid esters having a molecular weight within the range of 5000 to 25,000 and 0.5% by weight of a glycidyl ether.

Manufacture of Extreme Pressure Additives for Lubricating Oils—Patent #2,549,525—Kenneth Charles Roberts, assignor to The Anchor Chemical Co., Ltd.

In the production of extreme pressure additives for lubricating oils, the process which consists substantially in heating and reacting sulfur with an unsaturated ester of an aliphatic alcohol containing not more than two hydroxl groups and naturally occurring fatty acids containing from 16 to 24 carbon atoms, in the presence of a small amount of a dicyclohexylamine, at a temperature within the range of from about 130 to 180 C. and recovering the resulting sulfurized product.

Glass Molding Lubricant—Patent #2,549,535—Arthur C. Skooglund, assignor to Standard Oil Development Co.

A lubricating composition for molding glass, and the like, at high temperatures consisting essentially of 90 to 99.5% by weight of hydrocarbon oil having an end boiling point below the molding temperature, 0.1 to 5% of finely divided graphite and 0.4 to 5% of an alkyl ester of a fatty acid, said ester having not more than 6 carbon atoms in one group and 12 to 24 carbon atoms in the other.

Aqueous Emulsion and a Process of Making It—Patent #2,550,211—Andrew J Watters and David M. Shepherd, assignors to Imperial Chemical Industries, Ltd.

An aqueous emulsion wherein the aqueous phase constitutes the dispersion medium and the dispersed phase is comprised of a water-insoluble long chain aliphatic substance selected from the group consisting of oils, fats and waxes, the emulsion containing a minor proportion of a water-soluble methyl ether of cellulose in a concentration insufficient by itself to give effective emulsification of said water-insoluble substance and a major proportion of a water-soluble alkali metal salt of carboxy-methyl cellulose having substantially higher viscosity characteristics than said methyl ether.

Extreme Pressure Lubricants—Patent #2,550,406—Elmer B. Cyphers, assignor to Standard Oil Development Co.

A composition consisting essentially of mineral base lubricating oil containing 1 to 20% by weight, based on the total composition, of a sulfurized and phosphorized ester of an abietic compound esterified with an aliphatic compound of 12 to 22 carbon atoms, wherein one of said esterifying compounds is a carboxylic acid and the other is an alcohol, said sulfurized and phosphorized ester being prepared by first combining about 91 to 97 parts by weight of the ester with 3 to 9 parts of sulfur and heating to a emperature between about 280 F. and 450 F. for a period of 1 to 10 hours, and thereafter treating the sulfurized product with about 0.5% by weight of a phosphorus sulfide at a temperature between about 150 F. and 300 F. for a period of 1 to 24 hours.

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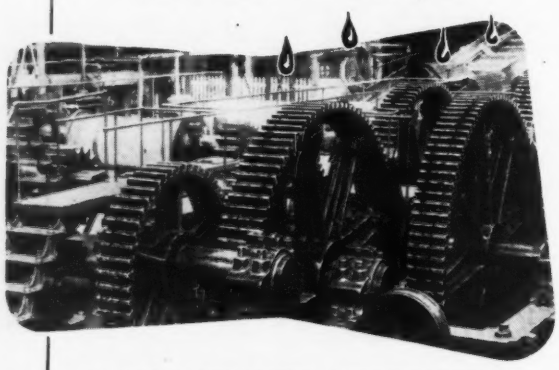

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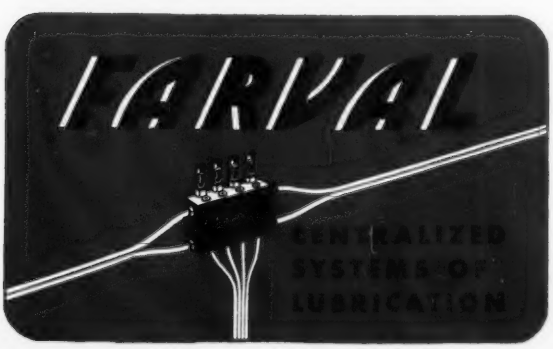

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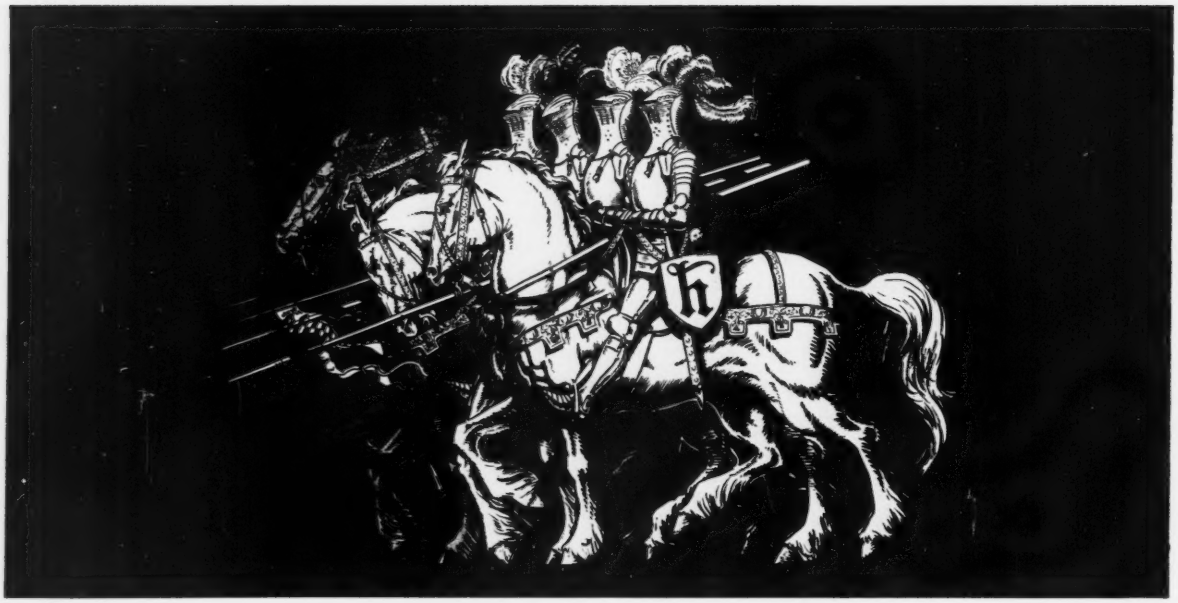

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